THE GUNONG BENOM EXPEDITION 1967

5. REPTILES AND AMPHIBIANS OF GUNONG BENOM WITH A DESCRIPTION OF A NEW SPECIES OF *MACROCALAMUS*

BY

ALICE G. C. GRANDISON

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5. REPTILES AND AMPHIBIANS OF GUNONG BENOM WITH A DESCRIPTION OF A NEW SPECIES OF *MACROCALAMUS*

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INTRODUCTION

Gunong Benom offered the herpetologist wide scope for sampling the reptiles and amphibians of both virgin and disturbed rain forest formations and for studying the altitudinal zonation of the species in natural climax vegetation. In the time available on the 1967 expedition it was possible to carry out only a relatively superficial survey, nevertheless the material collected included not only 79 known species of reptiles and amphibians, of which a few constituted additions to the West Malaysian fauna, but also an undescribed species of snake.

Base Camp was ideally situated in an area containing a wide variety of terrestrial, arboreal and riparian habitats in primary rain forest as well as in both recent and well established secondary growth in areas of disturbance associated with logging (see Whitmore, no. 2 of this volume). The many aquatic situations differed greatly in extent and flow. However, as expected, the specimens of greatest scientific interest were found at higher elevations, from 3–6000 ft, and it is unfortunate that more time and personnel could not have been employed in obtaining longer series of the forms from these altitudes. It is possible that streams at elevations beyond 4000 ft, harboured species in addition to those obtained near the two highest camps, for the partially underground stream near camp 4 at 5000 ft, being somewhat inaccessible and reached only by a precipitous, unstable and hazardous route, was not thoroughly searched after dark, nor was the broad, fairly shallow and fast flowing stream that appeared for a short distance above ground at ca 5800 ft. While no frog other than *Metaphrynella pollicaris* was heard above 5100 ft it is likely that the West Malaysian species known to occur at high elevations in other parts of their range have similar vertical distributions on Gunong Benom.

The herpetology of some of West Malaysia's neighbours, notably of Borneo, the Philippines and Thailand, has fairly recently been reviewed and excellent detailed monographs on the taxonomy and zoogeography have been published (Inger 1954 & 1966, Taylor 1962, 1963 & 1965). In contrast, the only major works on the herpetofauna of the Malayan peninsula were either published decades ago (Boulenger 1912, Smith 1930) or deal only with snakes (Tweedie 1954). Boulenger's 1912 work and Smith's 1930 list which is a supplement to Boulenger's, are still extremely useful reference books, despite their outdated nomenclature and subsequent additions to the list of species known in the peninsula. Tweedie's (1954) and Lim's recent reports have made significant contributions towards an understanding of the habits and distribution of snakes in the peninsula, but only Boulenger (1908), Smith (1922) and Lim (1963, 1964 & 1967) have reported collections from above 5000 ft.

ALTITUDINAL ZONATION

Boulenger (1908) reporting on the herpetological collection made by Wray and Robinson on Gunong Tahan mentions only four species taken at above 5000 ft: *Leptobrachium gracile* (5200 ft), *Rana hascheana* (5200 ft), *Rana Larutensis* [*Amolops larutensis*] (5200 ft) and *Psammodynastes pulverulentus* (5–5800 ft). Smith (1922) recorded the following additional species found on Gunong Tahan at similar altitudes:

Polydontophis collaris [Sibynophis collaris]	5400–5700 ft
Calamaria pavimentata	5400–5700 ft
Goniocephalus robinsoni	5400–5700 ft
Calotes floweri	6400 ft
Lygosoma [Siaphos] larutensis	5400–5700 ft
Philautus vermiculatus	5000 ft

From similar elevations on Gunong Benom only three of these Tahan species were obtained (*Amolops larutensis*, *Leptobrachium gracile* and *Philautus vermiculatus*) but five additional species were found, namely:

Pareas vertebralis	5000 ft
Macrocalamus sp. nov.	5800–6500 ft
Microhyla annectans	5000 ft
Metaphrynella pollicaris	5500–6250 ft (also 2950–4300 ft)
Philautus aurifasciatus	5000 ft

To these can be added the following high altitude snake species reported on by Lim (1963, 1964 & 1967) and collected on Gunong Brinchang in the Cameron Highlands, Pahang:

Typhlops diardi muelleri	5500 ft
Cylindrophis rufus	5500 ft
Elaphe porphyracea	6300 ft
Calamaria fraseri [C. lowi gimletti]	5000 ft
Calamaria gimletti [C. lowi gimletti]	5000 ft
Calamaria lumbricoidea	5500 ft
Collorhabdion williamsoni	6000 ft
Macrocalamus lateralis	5200–6300 ft
Macrocalamus tweediei	5000–6000 ft
Ahaetulla ahaetulla	5000 ft
Ahaetulla caudolineata	5000 ft
Chrysopelea paradisi	5000 ft
Lycodon butleri	6664 ft
Natrix chrysarga [Rhabdophis chrysarga]	5500 ft
Natrix sanguinea [Amphiesma sanguinea]	5500 ft
Natrix sarawakensis [Amphiesma sarawacensis]	5400–5500 ft
Pseudoxenodon macrops	6000 ft
Boiga jaspidea	5000 ft
Trimeresurus popeorum	5500 ft
Trimeresurus monticola	5700 ft
Gymnodactylus pulchellus [Cyrtodactylus pulchellus]	5000–6000 ft

Lim also provided useful information on the habitat preferences of the 18 species that he collected, as well as analyses of stomach contents.

In retrospect, it is obvious that on Gunong Benom it would have been worthwhile engaging the services of nimble tree climbers to search the canopy and the high side branches of well established secondary growth flanking the track. Such exercises would almost certainly have yielded longer series of *Philautus vermiculatus*, possibly female *Metaphrynella pollicaris*, some of the high altitude forms reported by Smith (1922) and by Lim (1963, 1964, 1967) and maybe other species. Many pairs of hands would have to be employed and a great deal of work done both by night and by day before it could be claimed that adequate sampling of Gunong Benom's herpetofauna had been accomplished. The results of the 1967 survey certainly suggest that the area would repay further and more intensive study.

Detailed taxonomic accounts for most of the species obtained on G. Benom have been omitted from this report since a high proportion of them occur also in either Thailand or Borneo, or both, and full descriptions of each species are available in Taylor's (1962, 1963, 1965) and Inger's (1966) monographs.

METHODS AND TERMINOLOGY

Measurements taken with dial calipers reading to 0·1 mm were as follows:

Body length: combined length of head and body, that is equivalent to the distance from snout to vent (abbreviated in text S–V).

Head length: the distance from the tip of the snout to the jaw articulation.

Head width: the greatest width of the head, usually at the position of the tympana.

Length of tibia: the distance from the convex surface of the knee to the convex surface of the tibio-tarsal joint, the measurement taken with the leg flexed.

Length of first toe: the distance from the tip of the digit to the proximal edge of the basal subarticular tubercle.

Length of fourth toe: the distance from the tip of the digit to the proximal edge of the basal subarticular tubercle.

Other measurements are explained where they appear in the text.

Ranges given for each species are based on published records and on material in the British Museum collections but records from the literature are quoted only if from the species accounts I can be reasonably confident that the identifications are correct. 'Borneo' is used here to refer to the whole island and thus embraces E. Malaysia (Sabah and Sarawak), Brunei and Kalimantan. 'W. Malaysia' is employed in preference to 'The States of Malaya' and is defined as the peninsular portion of the Federation of Malaysia; it thus excludes the provinces of Thailand south of the Isthmus of Kra.

Unless otherwise stated, all specimen numbers are those of the British Museum (Natural History).

GYMNOPHIONA

Family ICHTHYOPHIIDAE

Caudacaecilia nigroflava (Taylor)

Ichthyophis nigroflavus Taylor 1960 : 101.

Material: BM 1967.2775–80 (1 adult, 5 metamorphosed juveniles).

Habitat: The juveniles were found in mud and in sand at the margin of the stream near Base camp, 700 ft, during late afternoon. The adult (total length 420 mm) was found swimming in a 2 ft deep part of the clear, fast-flowing stream at Base camp.

Colour in life: The adult was a bluish-black with a clearly defined yellow, lateral stripe extending from below the eye to the vent. The stripe is also visible in the juveniles but in life was more cream and the body rather brownish.

Remarks: I am indebted to Professor E. H. Taylor for the identification of these specimens.

Range: W. Malaysia, Sumatra and Borneo.

SALIENTIA

Family **BUFONIDAE**

Ansonia leptopus (Günther)

Bufo leptopus Günther 1872 : 598.

MATERIAL: BM 1967.2765–70 (1 ♀, 5 ♂).

HABITAT: The specimens were obtained in a 200 yd stretch of the fast-flowing tributary of the River Kerau about 500 yds downstream from Base camp, 700 ft, at a point where the stream is bordered by dense primary forest. Four of the males were caught on top of stones in midstream while the fifth male was taken in amplexus with the female under a stone at the edge of the stream where the water formed shallow, still pools among stones and gravel.

COLOUR IN LIFE: Dorsum uniform brown. Venter spotted yellow or orange.

CALL: A soft chirp.

REMARKS. These specimens belong to the group of *Ansonia* species in which the tympanum is visible and the first finger reaches to the disk of the second. The only species in this group that is known to occur in the Malayan peninsula is *A. penangensis* but conspecificity with *penangensis* can be ruled out on account of size differences (topotypical *penangensis* gravid female measures 37·5 mm S–V while the gravid G. Benom female measures 51·0 mm) as well as differences in colour pattern, webbing and in the complete absence of a tarsal ridge in the G. Benom material. Bornean *A. leptopus* and *A. longidigita* also belong to this group and the G. Benom specimens have been compared with the holotypes and other examples of these species. The holotype of *leptopus* which is a gravid female is now flabby and somewhat faded but in size, snout shape, webbing and in the remnants of its ventral pattern there is close similarity to the Benom female. Its dorsum however is more coarsely granulate than in the Benom specimen but as Inger (1960) has pointed out, there is considerable variation in tuberculation in this species. The males have vocal sacs and openings, and nuptial pads developed over the entire dorsal surfaces of the first fingers; they vary in body length from 36·0–39·3 mm (average 37·7 mm). They are slightly more warty than the female and the short, oblique series of rather prominent warts above the tympanum in the holotype and in the Benom female is rather less well developed. In both sexes there is a single row, but occasionally double row of dark tipped spinules along both the upper and lower lips, along the canthal and supraorbital edges and as a vertical row at the tip of the snout.

RANGE: W. Malaysia and Borneo.

Ansonia ?tiomanica Hendrickson

Ansonia tiomanica Hendrickson 1966 : 74.

MATERIAL: BM 1967.2771–73 (2 ♀, 1 ♂).

HABITAT: All three individuals were found at night on leaves in the boulder strewn stream bed in the valley at ca 3400 ft below camp 3.

REMARKS: These specimens belong to the group of *Ansonia* species that have a visible tympanum and are without a tarsal ridge and in which the tip of the first finger does not reach as far as the disk of the second finger when the digits are adpressed. This group comprises the West Malaysian species *malayana* Inger and *tiomanica* Hendrickson, the Bornean and Sarawakian species *fuliginea* (Mocquard), *hanitschi* Inger, *platysoma* Inger, *latidisca* Inger and the S.W. Indian *ornata* Günther (Inger 1960).

The G. Benom material has been compared with type and other material of those species, except *tiomanica* of which no specimens at all were available, and while they have more characters in common with *malayana* and *tiomanica* than with the other species, there are distinctive differences.

DESCRIPTION: Habitus moderately slender; head slightly wider than long (measured from lower tip of snout to posterior rim of tympanum); snout truncate but a little pointed at tip, sloping in profile, nostril above or slightly anterior to symphysis; canthus rostralis sharp and slightly curved, lores straight and vertical; tip of snout laterally compressed, forming a well developed median, vertical ridge; interorbital

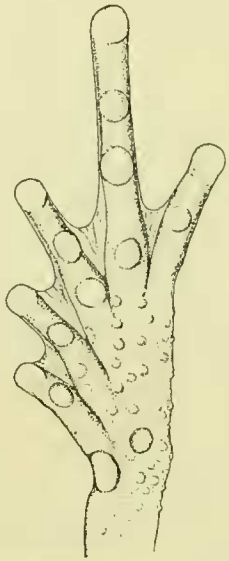

FIG. 1. Ventral view of the foot of *Ansonia tiomanica* (B.M. 1967.2773).

at narrowest point wider than upper eyelid; tympanum distinct, its horizontal diameter about half eye diameter and half internarial distance. Fingers slender, tips rounded, not wider than rest of fingers, no rudimentary web; first finger much shorter than second, length of first (measured from median edge of outer palmar tubercle) equal to eye diameter; fourth finger longer than second; subarticular tubercles feeble; a low, round, outer palmar tubercle. Tips of toes swollen into small, round disks; fifth toe longer than third by length of disk; broad webbing on toes leaves the following phalanges free from web in both sexes:

1st	2nd	3rd	4th	5th
$\frac{1}{2}$	$\frac{1}{2}$	$2–2\frac{1}{2} : 1\frac{1}{2}–2$	$3–3\frac{1}{2} : 3–3\frac{1}{2}$	2

Subarticular tubercles weak; two metatarsal tubercles, the outer oval, low and barely discernible, the inner round, slightly conical and much more conspicuous; no tarsal ridge.

Skin above markedly tuberculate with round, well spaced warts, the largest and most conspicuous above and below the tympanum, in a line along the dorso-lateral edge and on the flanks, each wart surmounted by usually one small, white or horn-tipped, conical tubercle. On top of head, on back and on upper surfaces of limbs similar but smaller warts of varying size all with spinose tips, those warts on limbs particularly spinose; interspaces shagreened. Surfaces of abdomen coarsely granular with scattered, small, spinose tubercles. Similar spinose tubercles scattered under chin and throat of females; in males spinose tubercles are horn-tipped and confined to 3–4 rows under mandible. A longitudinal opening into subgular vocal sac developed on right side of mouth but no nuptial asperities. Colour in life dark brown with yellow chrome spots on both upper and lower surfaces. A very prominent yellow chrome wart at angle of jaws below posterior rim of tympanum, its diameter at least 2/3 the tympanic diameter, much larger and more elevated than the yellow tubercles in the same area on two of the Perak paratypes of *malayana*. Upper and lower lips spotted yellow chrome. In two of the specimens a dark brown cruciform pattern on the back can be detected. This pattern is reminiscent of the *malayana* pattern which is particularly well developed in the Thailand paratypes and consists of two clearly marked crosses, one between the shoulders, the other immediately behind, and between the two 'Xs' a light patch but in neither G. Benom specimen is the interscapular light spot evident and the arms of the crosses are obscure. Limbs with indistinct light bars on which there are numerous yellow spots. Undersurfaces of head, body and limbs dusky with numerous very small yellow chrome spots similar to the Perak holotype and paratypes of *malayana*.

A. malayana is known to occur in the Larut Hills, Perak at 3–4000 ft and at Chumporn, Tasan, S. Thailand. British Museum individuals obtained at Ipoh and on G. Tahan may also be referable to this species. From *malayana* the G. Benom specimens differ in the following characters:

1. Absence of sexual dimorphism in the extent of toe web.
2. Several rows (3–4) of very small, closely set spinules under the mandible (in *malayana* males a single row of well-spaced spinose tubercles).

3. Greater body length. In G. Benom specimens the female measures 30·2 mm from snout to vent and the male 25·4 mm, whereas the female paratypes of *malayana* vary from 26·0–28·0 mm and the four mature males 20·2–23·2 mm.
4. A large, conspicuous yellow wart at the angle of the jaws whose diameter is at least 2/3 the tympanic diameter.
5. A more tuberculate dorsum.
6. Slightly less webbing on the 3rd and 5th toes.

A. tiomanica is known from only the two syntypes, an adult female and an adult male taken at Ulu Lalang, Pulau Tioman. Comparison with this species is hampered not only by an absence of material but by the discrepancies between Hendrickson's description of the types and the figures he gives of the hand and foot (1966). He describes the disks of *tiomanica* as being spatulate but the drawings show rounded tips similar to those of *malayana* and of the G. Benom individuals. The tips of the 3rd and 4th fingers although described as being twice as wide as the narrowest portion of those digits are not so figured and the number of phalanges free from web is considerably greater in the figure than in the text. If one assumes that Hendrickson's text is accurate there is apparently little to distinguish the G. Benom specimens from *tiomanica*, except greater size (*tiomanica* ♀ 36·3 mm, ♂ 31·2 mm), absence of mandibular asperities, the greater elevation of the inner metatarsal tubercle, the presence of a central, low metatarsal tubercle and possibly also a more reduced web on the 1st and 2nd toes although no details are given of the extent of the web on those digits. The difference in mandibular asperities might well be a reflection of the sexual maturity of the male *tiomanica* and the other differences due to geographical variation and until longer series are available assignment of the G. Benom specimens to *tiomanica* can be only tentative.

Bufo asper Gravenhorst

Bufo asper Gravenhorst 1829 : 58.

MATERIAL: BM 1967.2726–37, 2774 (1 ♀, 7 ♂, 2 halfgrown, 2 juveniles, 1 skeleton).

HABITAT: All adults were obtained from the boulder strewn tributary of the River Kerau or from its immediate vicinity at ca 700 ft. At night numerous individuals were to be seen between and on the large boulders, particularly at the side of a quiet deep backwater close to Base camp. On the forest litter near the stream at camp 3 and on the laterite logging track near camp 1 other examples were taken. No *Bufo asper* were seen or heard on G. Benom above 3430 ft.

RANGE: Peninsular Thailand and Burma, to Java and Borneo (Inger 1966).

Bufo parvus Boulenger

Bufo parvus Boulenger 1887 : 346.

MATERIAL: BM 1967.2738–58 (1 ♀, 19 ♂, 1 juvenile).

HABITAT: The series was obtained mainly from the floor of disturbed forest at 700 ft, most individuals being under twigs and felled branches in muddy patches, within 200 yds of the stream. One male was taken on bare clay some 500 yds from water. A pair in emplexus were at the margin of the stream where the water was shallow and with little current. One specimen was found in virgin forest at 1600 ft.

COLOUR IN LIFE: The paratoids, limbs and the vertebral blotches pinkish, the general ground colour of the dorsum russet brown. The throat, belly and undersurfaces of hind limbs light grey or cream, lightly spotted with dark brown. The throat of one male blackish.

CALL: crow-ack repeated quickly six times and followed by a short interval.

RANGE: Peninsular parts of Burma, Thailand and Malaya, Sumatra (Taylor 1962).

Cacophryne borbonica (Tschudi)

Hylaplesia borbonica Tschudi 1838 : 70.

MATERIAL: BM 1967.2759–60 (1 ♂, 1 ♀).

ECOLOGY: Found at ca 700 ft on Benom, a considerably lower elevation than has previously been reported for the species. Inger (1966) reported that *borbonica* has been taken from 600–1500 metres in Borneo and Sumatra, and in Thailand specimens have been found in hilly country. The adult female was found after heavy rain, in disturbed forest at night on the dead branch of a low bush at approximately 18″ from the forest floor, at the edge of the Base camp track. The male was taken on the steep clay bank of a still backwater of the stream close to Base camp.

COLOUR IN LIFE: Ground colour of upper surfaces of the female greyish-brown with a pair of black mid-dorsal spots between the orbits and between the paratoid glands. On the middle of the back in the sacral region there is a conspicuous hourglass-shaped dark mark, which is separated from the occipital spots by a light diamond-shaped area. The dorso lateral series of glandular tubercles is noticeably lighter than adjacent areas. Upper lips spotted dark brown. Irregularly-shaped dark blotches on flanks that have a tendency to form oblique stripes. Limbs with dark crossbars. Groin, inside of knee and heel joint pinkish-red. Belly cream; throat and chest brownish. The only pattern visible in the male consists of a pair of small dark inter-orbital spots, a pair of dark sacral spots and somewhat indistinct labial spots and cross bars of the limbs. Throat and chest although brownish are lighter than in the female.

SECONDARY SEX CHARACTERS: Sexual dimorphism is marked, the female, which has enlarged darkly pigmented ova, being 42·5 mm while the male, which has a median subgular vocal sac with a long slitlike opening on the left side of the floor of the mouth and nuptial asperities on the entire dorsal aspect of the first finger

and median surface of the first metacarpal, measures 27·7 mm. Comparable size difference between sexes was noted by Inger (1966) for equally mature Bornean samples.

RANGE: Peninsular Thailand and Malaya, Sumatra, Java and Borneo (Inger 1966).

Pelophryne brevipes (Peters)

Hylaplesia brevipes Peters 1867 : 34.

MATERIAL: BM 1967.2761–4 (1 ♂, 1 ♀, 2 hgr. ♀).

HABITAT: Number 2761 was found by torchlight at night and 2762 in daylight during the morning after heavy rains, 2 ft from the forest floor on a sodden tree stump near the edge of a stream in the valley below camp 2, about 1600 ft. Examples 1967, 2763–4 were taken near Base camp, on the rough bark of a tree, about 5 ft from the ground, by the side of a disused logging track at approximately 800 ft.

COLOUR IN LIFE: The most striking feature of the colour pattern, particularly at night in torchlight, was the creamy yellow band of varying width which starts below the eye, passes below the tympanum and extends backwards to the groin, leaving a dark brown spot on the upper lip in front of the jaw angle and merging on the flanks with the yellowish, black spotted venter. The band was bordered above by a narrow dark chocolate brown zone. The upper surface of the head and the median dorsal area that is of cruciform shape, a yellow-brown with orange-red tubercles. The cruciform area was outlined in chocolate brown, the sides of the body reddish brown with numerous orange-red tubercles. The throat of the adult male was grey-brown mottled with yellow, that of the female predominantly yellowish with dark brown spotting. The limbs were yellow-brown with dark brown crossbands and orange-red tubercles. The iris was orange-red.

REMARKS: These specimens closely resemble the syntypes of *Nectophryne signata* Blgr. and cruciform patterned examples of *Pelophryne brevipes* as described by Inger (1966) who placed *signata* in the synonymy of *brevipes*.

SIZE: The female with enlarged ova measures 18·8 mm in body length, the two immature females 17·2 and 17·5 mm. The male which has a vocal sac, single rows of mandibular spines and poorly developed thumb pads measures 16·3 mm from snout to vent.

RANGE: Malay peninsula including Aor Island and Singapore, Natuna Islands, Mentawei Islands, Sumatra, Borneo and Mindanao (Inger 1966).

Family **MICROHYLIDAE**

Chaperina fusca Mocquard

Chaperina fusca Mocquard 1892 : 35.

MATERIAL: BM 1967.2665–69 (2 ♂, 4 ♀).

HABITAT: 1650–1750 ft near camp 2. One example was caught under a fern on wet clay at the side of the track, and one specimen was obtained on wet clay close

to a sodden fallen log above the section of the small stream in which *Leptobrachium heteropus* occurred on the low plants. Other examples, taken nearer to camp, were found in amplexus at night in small 2″ deep pools in the track formed by prolonged rain in footprints. Although the water in these pools was turbid, no doubt due to the intensity of the rain stirring up the soil, it was humus free. Inger (1966), on the other hand, found that mating *fusca* were always in pools rich in humus and never in ones that lacked putrid material.

Colour in life: Upper surfaces of body jet black with numerous tiny whitish-yellow flecks. Limbs brown with darker brown crossbars and scattered light flecks. Belly with a bold reticulate pattern of citron yellow and black.

Range: The occurrence of this species in Pahang extends its known range. The only West Malaysian State from which Inger (1966) recorded the species is Perak. Elsewhere *C. fusca* occurs in Borneo and the southern Philippine Islands.

Kalophrynus pleurostigma pleurostigma Tschudi

Kalophrynus pleurostigma Tschudi 1838 : 86.

Material: BM 1967.2670 (1 ♂).

Habitat: At 700 ft in disturbed primary rainforest. Under dead leaf in a ditch at side of logging track close to Base camp. Calling at night.

Range: W. Malaysia, Sumatra, Borneo, S. Philippines (Inger 1966).

Metaphrynella pollicaris (Boulenger)

Phrynella pollicaris Boulenger 1890 : 37.

Material: BM 1967.2695–2719 (1 ♀, 23 ♂, 1 juvenile).

Ecology: Between 2950 and 6250 ft. Except for BM 1967. 2719, the entire series consists of adult males and one gravid female obtained from holes in trees between 4 and 30 ft from the forest floor. No tree that was less than 3″ in diameter was found to harbour the species. The elliptical holes, possibly made by the larvae of long horn beetles, continued down the centre of the tree trunks and at their bases, sometimes a foot below the opening to the exterior, in a pool of peaty water a specimen or a pair were to be found. At the time of the G. Benom visit I was unfamiliar with Wray's method (1890) of expelling *pollicaris* from their tree holes by first pouring in water then dropping in salt. His technique was apparently not only fruitful but would be less damaging to the frogs and to their niches than our practice of opening up the holes with a bush knife. The highest elevation at which *pollicaris* was present on Benom seems to be 6700 ft at which height it was still to be heard. Above 3500 ft it was the only anuran heard calling both by day and by night. It was not heard on the true summit nor on subsidiary summits where the vegetation was drier (leptospermum, orchids and rhododendrons) and the trees on average much shorter (15–20 ft), but only on the slopes, in the valleys

and at certain elevations on the ridge followed by the expedition. On the narrow ridge between 4300 and 5500 ft no examples were obtained and no calls of *pollicaris* were heard so there seems to be a gap in the vertical distribution of this species on Benom.

Wray, who obtained the type specimen in the Larut Hills, described the call as 'a loud flute-like musical note uttered at irregular intervals principally during the night' (in Flower 1896) and as 'pretty flute-like notes' (Wray 1890). On Benom the call of *pollicaris* emitted by a single individual was usually a single 'COOP' repeated at regular 15 sec. intervals but in areas where several individuals were calling the sound resembled distant cow bells. The pitch and volume of the call seemed to be related to the size and depth of the cavity occupied by the frog, a loud deep burp being emitted from individuals occupying large deep holes and a lighter thinner 'COOP' from those in narrow holes with slit-like openings. A similar observation on the resonant qualities of the hole was made by Wray (in Flower 1896).

Despite thorough searching, the litter and low vegetation yielded no adult *pollicaris*. One juvenile, BM 1967. 2719, was found on a fern about a foot above the forest floor at 3500 ft close to camp 3 soon after the botanist's collectors had been active in the tree canopy. It seems possible that *M. pollicaris* normally occupies the canopy and that adults descend to tree-holes solely for breeding purposes. This mode of life would explain the absence of the species from low trees, bushes and the forest floor. (The juvenile discovered close to the ground could have been dislodged by the botanical collectors working in the high branches.) It would further account for our finding only one adult female in the tree holes. Of the examples of *pollicaris* obtained in the Larut Hills around the turn of the century, only one was taken from other than a tree hole; it was found in a crevice in a rockery of a house at 4513 ft (Butler 1904). Although the botanical collectors on the G. Benom expedition were asked to be on the look out for frogs in the tree crown they did not report seeing any: nevertheless I believe that there is a distinct possibility that careful inspection of high branches and foliage might disclose the full life history and habits of this species.

The Bornean species of *Metaphrynella* has also been found in tree holes, and little apparently is known of its life history except that males call from April to August and a gravid female was found in June (Inger 1966). The gravid female of *pollicaris* was obtained in March.

Variation: In the males there is a marked size variation associated with altitude, individuals from 2950 to 4000 ft varying from 29 to 33 mm in body size while those obtained at 5500 to 6250 ft are between 35 and 40 mm. No other morphological differences in these populations have been found.

Only one adult female *pollicaris* being available it is impossible to be certain whether there is a constant sexual difference in the length of the pollex. However in the single female the tip of the pollex does not project beyond the distal edge of the subarticular tubercle of the first finger whereas in males the tip extends well beyond and in some individuals as much as 3/4 the length of the tubercle.

Colour in life: In most individuals the dorsal pattern is obscure but in some

specimens there is an indication of a dark chocolate brown hour-glass shape which begins between the eyes as a broad band, widens on the mid dorsum and becomes more constricted in the sacral region. The most constant feature of the pattern is a dark patch over the anus which is surrounded by a broad light area. Across the femur, distal to this light area, are alternate dark brown and light stripes which do not encircle the thigh but peter out on the posterior edge of the thigh. Tibia, tarsus and foot crossbarred; heel invariably cream.

RANGE: W. Malaysia.

Microhyla annectans Boulenger

Microhyla annectans Boulenger 1900 : 188

MATERIAL: BM 1967.2671–77 (2 ♀, 5 ♂).

HABITAT: Four of the Benom samples were found at night in a small water-filled artificial depression on the forest floor close by camp 4 (5000 ft). They were lying motionless and spread eagled on the water's surface, resembled dead leaves and made no attempt to dive or swim away when disturbed, unlike individuals obtained by Butler in the Larut Hills (Butler 1904). Other specimens were on the peaty soil of the trail close to a similar pool. One example which was on a fallen palm leaf flattened itself when disturbed. The holes had been excavated three days previously in the hope of water seepage from the ground or rain filling them and attracting frogs to them but although the holes soon filled with water and the pools were regularly inspected no frogs were seen until the third and last day spent at the camp. Butler (1904) obtained the syntypes of *annectans* at the margin of a small pond in jungle on the Larut Hills at about 4000 ft, in association with *M. butleri*. He caught nine examples and comments that he 'could easily have obtained many more. When disturbed they at once jumped into the water usually rising with eyes above the surface a few seconds later.'

COLOUR IN LIFE. The upper surfaces of the frogs closely resemble the forest litter of peat and reddish fallen leaves. The dorsum is a rich red-brown or almost a claret colour and the snout is a lighter brown. The symmetrical dorsal patch and the spots and blotches on the flanks, on each side of the vent and on the limbs are a rich dark chocolate brown. The belly is mottled white and black. The ground colour of the upper surfaces is similar to that of *Leptobrachium gracile* found in the same area. All the examples have an oblique whitish line from below the eye to the jaw angle but in some specimens this line continues almost to the axilla as a series of white spots. All have a prominent black patch extending from above the shoulder almost to the groin which is bordered above by a thin white line. On the inside of the upper leg are equally prominent dark patches which extend to the knee. Dark areas are also present on the heel, as black spots on each side of the vent and as crossbars on the femur and tibia. In two individuals the sacral dark bar is reduced to two dark spots or ocelli lying on either side of the vertebral region. None of the Benom series nor the types has a black labial spot (see also taxonomic notes). There appears to be no sexual dichromatism.

Taxonomic notes: The 'adult Malayan male BM 1928.11.12.1' to which Inger (1966) referred in his discussion of *annectans* not only hails from Thailand but differs in several respects from the syntypes of *annectans* and I believe has been incorrectly assigned to this species. The canthus is feebly defined and the loreal region is more oblique than in *annectans*. The third finger length is considerably less than the distance from the tip of the snout to the pupil, in fact is equivalent to snout tip to the anterior border of the eye. In *annectans* the internarial distance equals the length of the fourth finger, whilst in BM 1928.11.12.1 it is twice the length of the fourth finger. The webbing on the toes is less extensive than in *annectans* and on the external aspect of the third toe two phalanges are free whilst the fourth toe has three phalanges free from web on both inner and outer aspects and the fifth toe has almost two free phalanges. Furthermore the snout to vent length (20 mm) is well outside the size range of adult male *annectans* (14·5–15·4 mm). The specimen was collected by Malcolm Smith but has been labelled as having been obtained in Perak. Reference however to Smith's field notebooks indicates that it was in fact collected in January 1916 at Patuju and Smith (1916 & 1930) refers to this individual and states that Patiju (sic) is a state about 60 kms north of the Isthmus of Kra (now Chumphon according to Taylor (1962)). In 1928, but shortly before Smith's specimen was incorporated into the British Museum, Parker published his review of the genus *Microhyla* and, based on Smith's (1916) Patuju record, included Peninsular Siam in the distribution of *M. annectans*. He further incorporated in his description of the species the unusual features of the Patuju specimen that had been mentioned by Smith (1916), namely the black labial spots, black oblique streaks from the eyes to the axillae and the thin light vertebral line, all of which are absent from the syntypes as well as from the G. Benom series, and in 1934 he again modified the description of the syntypes to include the Patuju individual although by this time the specimen was masquerading as a Perak example and is listed as such by Parker. I have also examined 27 specimens from the Field Museum Chicago collections that were obtained in the 3rd and 4th divisions of Sarawak and had been tentatively assigned to *M. annectans*. They differ so radically from the syntypes and from the Benom sample in the development of the fingers that I suspect more than geographical variation is involved and that they almost certainly should be recognized as belonging to a separate taxon. As Inger (1966) has pointed out, Bornean '*annectans*' have no free first finger whereas in the Malayan examples and syntypes the length of the first finger, measured from its tip to the base of the palmar tubercle is equivalent to the distance from the middle of the naris at least as far as the anterior border of the eye. But not only is there reduction in the length of the first finger. Whereas in Malayan material the internarial distance equals the length of the 4th finger, in the Sarawak '*annectans*' it is $1\frac{1}{2}$–2 times the length of the 4th finger. The 3rd finger measured from its tip to the base of the proximal subarticular tubercle (at junction with 4th finger) is relatively shorter than in Malayan *annectans* and is equivalent to the distance from the tip of the snout to the anterior border of the eye (middle of the eye in *annectans*). In the description of Bornean '*annectans*' given by Inger (1966) it is stated that the fourth toe has two phalanges free from web but in the series of

Sarawak individuals that I have seen the web usually extends to the base of the disk or at least to beyond the distal edge of the distal subarticular tubercle. This is a considerably fuller web than is developed in the *annectans* syntypes and in the G. Benom series.

RANGE: W. Malaysia.

Microhyla berdmorei Blyth

Engystoma (?) *berdmorei* Blyth 1856 : 720.

MATERIAL: BM 1967.2678–9 (2 gravid ♀).

HABITAT: On disused logging track to K. Damak by banana stands in disturbed forest ca 600 ft.

COLOUR IN LIFE: Pink/grey dorsum with dark mushroom scapular and sacral marks and cross bands on hind limbs. Flanks, belly and undersurface of thighs sulphur yellow, chest creamy yellow, throat grey/brown speckled with dark brown.

REMARKS: In the larger of the two specimens (S–V 30·2 mm) the wartiness of the skin is more or less confined to the upper surface of the head and to the anal region, whereas in the smaller individual (S-V 28·2 mm) the entire dorsal surfaces of head, body and limbs are warty and the granulation extends beyond the vent to the posterior portion of the belly.

RANGE: Burma, Thailand, Cambodia, W. Malaysia and Sumatra.

Microhyla butleri Boulenger

Microhyla butleri Boulenger 1900 : 188.

MATERIAL: BM 1967.2680–81 (1 ♂, 1 ♀).

HABITAT: The male 2681, was found at 600 ft, at night about one mile from Base camp towards K. Damak after heavy rain, on a low bush by the side of the logging track where *Microhyla heymonsi* was breeding in puddles. Nearby and among the stands of banana *Rhacophorus nigropalmatus* was collected. The female was brought in by one of the mammalogists and no precise habitat details are available.

COLOUR IN LIFE: The large dorsal mark which Parker (1934) described in detail fits the Benom specimens admirably but is not light edged. The oblique light stripe from behind the eye to the axilla is prominent and bordering the stripe behind is a dark brown triangular spot. No reddish colouration of the tubercles was noted.

RANGE: Burma, Thailand, S. China, Vietnam, Hainan, W. Malaysia, Singapore.

Microhyla heymonsi Vogt

Microhyla heymonsi Vogt 1911 : 181.

MATERIAL: BM 1967.2682–94 (7 ♂, 6 ♀).

HABITAT: Close to rain puddles and small low plants on disused logging track to K. Damak, 600–700 ft, flanked by recent secondary growth and banana stands in rain forest.

CALL: k-r-r-i-c-k, k-r-r-i-c-k repeated at regular intervals.

REMARKS: The fine light vertebral line which Parker (1934) found to be generally present in examples of *heymonsi* is clearly discernible in all the individuals in this series; furthermore each has a small dark spot on each side of the line on the middle of the back. More than half the sample, males as well as females, have an additional pair of similar spots between the shoulders. No other dorsal spots are present. In morphology and in other aspects of colour pattern the Benom series agree fully with Parker's detailed description of the species.

RANGE: From Thailand through Vietnam to S. China, also W. Malaysia, Singapore and Sumatra.

Phrynella pulchra Boulenger

Phrynella pulchra Boulenger 1887 : 346.

MATERIAL: BM 1967.2720–24 (1 ♀, 4 ♂).

HABITAT: The series emanated from diverse microhabitats: rim of the washing-up bowl on the mess floor, a porter's bed, groove in the trunk of a felled tree, on the muddy logging track. All were found at night during or after heavy and prolonged rains at Base camp, 700 ft.

COLOUR IN LIFE: The general colour of the upper surfaces of four specimens was grey and black but one specimen (2724) was grass green on the posterior half of the body. The belly of all five was vivid vermilion and this colour continued on to the undersurfaces of the hind limbs and formed a broad supra-anal band and bright lumbar patches on the flanks. The throats of both the males and the females were black and the thoracic region speckled black.

RANGE: W. Malaysia, Sumatra, Mentawei Is.

Family **PELOBATIDAE**

Leptobrachium gracile Günther

Leptobrachium gracile Günther 1872 : 598.

MATERIAL: BM 1967.2297–8 (1 gravid ♀, 1 ♂). BM 1967.2299–2308 (developmental series at early and late metamorphic stages).

HABITAT: The two adults taken close to camp 4 (5000 ft) were found at night on plants about 2 ft above the forest floor. The series of nine larvae were obtained

in a clear, almost still pool in a narrow, slow moving stream (ca 3430 ft) in the valley below camp 3. The pool, with fine gravel bottom and about 2 ft deep, was surrounded by large stones and boulders among which the tadpoles darted when a torchlight was shone on the water's surface. On the stream's bank, alongside the pool and on a low broad-leaved plant by a boulder, specimen 2299 (in which the mouth is adult in form and the tail partially resorbed) was taken.

Colour in life: The adults were a mottled dull claret with a dull coral red on the upper arms. The tubercles on the upper surfaces of body and limbs were bright orange red, those on the flanks and hind limbs being wholly or partly encircled with dark brown. The iris, canthal edge, rim of eyelid, supratympanic fold and the flat round glands on each side of the thorax near the axillae were also orange-red. When alive the larvae were uniform reddish-brown.

Remarks: The adults (♀ S–V 47·2 mm: ♂ S–V 33·8 mm) agree favourably with Boulenger's (1908) and Inger's (1966) descriptions of the species except that in the Benom individuals the interorbital area is broader not narrower than the upper eyelid. The premetamorphic larvae have the typical pelobatid mouthparts and all have short rows of labial teeth, the dental formula being $\frac{\text{I: } 2\text{–}2}{3\text{–}3\text{: I}}$ in six specimens. In the three other larvae the formulae are $\frac{\text{I: } 1\text{–}3,}{3\text{–}3\text{: I}}$ $\frac{\text{I: } 2\text{–}2,}{2\text{–}2\text{: I}}$ $\frac{\text{I: } 2\text{–}2.}{3\text{–}3\text{: I}}$ These counts are within the variation observed by Inger (1966) in Bornean samples of *gracile*. However total lengths of the Benom larvae differ markedly from those in Inger's series and there apparently is a further difference in tail shape. The Bornean larvae varied between 25·0 and 47·0 mm in total length and the tail tips were described by Inger as rounded, while the Benom larvae with undamaged tails are 59·1–78·2 mm (M 69·7 mm) and their tails taper rapidly to a sharp point. The larvae of *L. heteropus*, which is the only other species of *Leptobrachium* so far found on Benom, are not known. In total length the Benom specimens are similar to *L. hasselti* but there the similarity ends for in proportions and in other characters there are many differences between the larvae of the two species. Larvae of *hasselti* are much less streamlined and fish-like in appearance, are heavily spotted all over, have a convex, dorsal fin that is as deep as the caudal muscle, except in the proximal third of the tail, and have a bulbous head and body that in width is only a little more than two-thirds of its length and in length is 1/2–2/3 the total length; in depth the head and body are considerably greater than the tail. *L. gracile*, on the other hand, has an elongate tadpole with head and body only 1/3 of the total length and in depth much less than the depth of the tail. The tadpoles of all other Malayan species of *Leptobrachium* are either much smaller or in pattern and in mouthparts differ from the Benom material. Although *L. pelodytoides* tadpoles in proportions are similar, in total length (63 mm) and in pattern (speckled and spotted with black) they differ from the G. Benom series.

Range: W. Malaysia and Borneo.

Leptobrachium heteropus Boulenger

Leptobrachium heteropus Boulenger 1900 : 186.

MATERIAL: BM 1967.2309–17 (9 ♂).

HABITAT: All the examples except one were found on leaves of small plants, no more than 1 ft from ground, in or near a shallow, narrow, slow moving stream in the valley below camp 2, approximately 1650 ft. The exception was found at a similar height from the ground calling from a tree stump in wet clay in the stream bed.

SECONDARY SEX CHARACTERS: The males have small, round, paired openings to the vocal sac on a level with the jaw angles and close to them. The gular skin is puckered. There are no nuptial pads or pectoral glands.

RANGE: Previously known only from the holotype obtained in the Larut Hills, Perak at 3500 ft although a few specimens obtained at Taman Negara, Pahang that are in the University of Malaya collections have been tentatively assigned to this species.

Megophrys aceras (Boulenger)

Megalophrys montana var *aceras* Boulenger 1903 : 132.

MATERIAL: BM 1967.2325–27 (2 ♀, 1 ♂).

HABITAT: The females were found at night on the peaty ground of the forest floor in the boulder strewn area of the ridge at 3650 ft, one specimen being at the back of the overhang of a large boulder. The male was taken on a boulder in the forest near to the stream in the valley below camp 3 at ca 3400 ft.

CALL: A single note, like that from a tuba, heard at night in the area in which the male *aceras* was found, may be the call of this species. The only other species of amphibian collected in the area were *Philautus aurifasciatus*, *Amolops larutensis*, *Leptobrachium gracile*, *Bufo asper* and *Ansonia ? tiomanica*.

COLOUR IN LIFE: The most striking feature of this species is the vivid vermilion of the iris and insides of the thighs. The dorsum is steel grey, paler on top of the head except for a large black triangular mark on the occiput and eyelids. There is a somewhat obscure, dark spot on the middle of the shoulders at the apex of the V-shaped fold. Additional black spots are present on the flanks, especially in the male, and in all three examples some black streaks or coalescing spots occur along the dorsolateral fold. Undersurface of the upper eyelid is spotted black. Black spots along the back of the upper arm, below the elbow and under the wrist. Narrow, oblique dark crossbars on the hind limb; dark patches on the chest, along the midline of the throat, below and behind the axilla; venter otherwise mottled grey and white. A round, black spot on the knee and 3–4 black spots on the hind edge of the tibia. Inside of the heel, undersurface of the tarsus and metatarsus black. Entire posterior surface of the thigh with very fine, white speckling but a black area over the vent extends along the thigh as a broad band and 2/3 along the thigh in the middle of this dark, thigh band is a single white spot. A white, pectoral conical tubercle on each side.

SECONDARY SEX CHARACTERS: Male *aceras* examined by Smith (1926) had a snout–vent length 49–57 mm. The male syntype and the G. Benom male, both of which are sexually mature, are 48·1 and 51·1 mm respectively. Smith's two females measured 75 and 83 mm; the two females in the G. Benom collection, both of which contain ripe, unpigmented eggs, have a body length of 82·2 and 85·6 mm. In the G. Benom male the entire dorsum, upper surfaces of the limbs, the sides of the head, the lips and the chin are beset with small, white horn-tipped tubercles. The mediodorsal surface of the basal half of the first finger bears a dark nuptial pad and there is also a small, roundish group of asperities on the basal knuckle of the second finger. A median, subgular, internal vocal sac is present; it opens by paired, round openings which lie near but a little behind the commissure of the jaws.

REMARKS: I find the following characters to be reliable for separating *M. aceras* from *M. monticola nasuta*:

1. On the back a single pair of curved, longitudinal folds that splay out on the shoulder region and end on the haunches about 7/8 of the way along the trunk. The folds start on or just above the supratympanic folds at the level of, or a little behind the posterior rim of the tympanum.
2. Absence of dermal appendage on the snout and at jaw commissure.
3. Dermal projections from the edge of the upper eyelids either absent or small (up to 2 mm).
4. Inner metatarsal tubercle 4/5 length of first toe.
5. Absence of transverse occipital fold.
6. Presence of a V-shaped or hourglass-shaped ridge or line of tubercles between the shoulders.
7. Width of head only very slightly greater than its length (less than $1\frac{1}{4}$ times).
8. Tympanum clearly discernible, its diameter $\frac{1}{2}$ internarial distance.
9. Loreal region vertical, lips not flaring.
10. Iris vermilion in life.

RANGE: Peninsular Thailand and Malaya.

Megophrys monticola nasuta (Schlegel)

Ceratophryne nasuta Schlegel 1858 : 57.

MATERIAL: BM 1967.2318–24 (1 ♀, 5 ♂, 1 juvenile).

HABITAT: Most of the examples were found at night on the forest floor among dead leaves in areas close to streams, between 600 and 1650 ft. One adult male was found at night sitting upright in the stream by fallen leaves, between boulders, just below the small waterfall at 1650 ft in the valley below camp 3.

COLOUR IN LIFE: Above tan or chocolate brown, the middle of the trunk from behind the orbits to the vent a darker shade, this area being bordered anteriorly by a wide angled 'V'. One or two dark brown transverse stripes across the top of the head. A dark brown, white bordered loreal patch and an oblique dark chocolate brown, sometimes white-edged stripe from below the posterior half of the eye to the upper lip were constantly present. A few, small, round, conical,

almost black tubercles irregularly scattered over the back. Across the vent a dark brown area with median constriction. Throat and chest usually chocolate brown or grey-brown mottled with darker brown and with a dark, median band; belly marbled brown and cream. A dark brown spot under forearm and dark patches under wrist and on knee; under surfaces of tarsus and metatarsus dark chocolate brown. Iris medium brown.

Remarks: Inger (1954) has given an excellent and detailed description of *monticola* and an account on geographic variation and the characteristics of *monticola nasuta*. See also remarks under *M. aceras*.

Range: Malay Peninsula, Sumatra, Natuna and Borneo (Inger 1954).

Family **RANIDAE**

Amolops larutensis (Boulenger)

Rana larutensis Boulenger 1899 : 273.

Material: BM 1967.2328–57, 1967.2489–91 (7 ♀, 17 ♂, 9 immature).

Habitat: 700–5000 ft in disturbed rainforest and in primary forest. The species was common at night on large, wet boulders in the fast-flowing stream at Base camp but became progressively rarer at higher altitudes, only two examples being found at 3400 ft and one at 5000 ft, but these occupying a similar niche to those in the lowlands.

Range: W. Malaysia.

Rana blythi (Boulenger)

Rana macrodon var. *blythi* Boulenger 1920 : 43.

Material: BM 1967.2423–34, 1967.2435, 1967.2500–01 (6 ♀, 5 ♂, 4 juveniles).

Habitat: 500–1600 ft in both narrow and wide, clear streams among virgin forest, generally on stones or on the banks.

Remarks: Females vary in body size from 71·7 to 147·5 mm, five that have well developed ovarian eggs and convoluted oviducts ranging from 71·7 to 81·6 mm. The five males measure from 83·7 to 98·2 mm. In head proportions and in tibia length, as well as in other characters, they agree closely with the proportions given by Inger (1966) for a series of Malayan *blythi*. In the G. Benom specimens the head width to snout–vent ratio is 0·337–0·374 (♀♀), 0·366–0·386 (♂♂), head length to snout–vent 0·383–0·421 (♀♀), 0·443–0·477 (♂♂) and the tibia to snout–vent ratio is 0·546–0·582 (♀♀), 0·521–0·557 (♂♂). They further agree with Inger's Malayan sample in lacking a dark, horizontal loreal stripe. Four individuals have a broad mid-dorsal light band, one has only a thin, light line. Inger states that male *blythi* lack vocal sacs, nuptial pads and any other distinctive (secondary sex) structures but in the G. Benom sample the bony mandibular projections are considerably better developed in males.

Range: W. Malaysia, Singapore, Sumatra and Borneo.

Rana chalconota raniceps (Peters)

Polypedetes raniceps Peters 1871 : 580.

MATERIAL: BM 1967.2436–59 (20 ♂, 4 ♀).

HABITAT: The females were found on stones and boulders splashed by spray in the stream at Base camp (700 ft) and also among bank-side vegetation. All the males were around the quiet backwater to the stream, either on the muddy bank or sitting on branches of trees overhanging the water (see also *Rana signata*).

COLOUR IN LIFE: Dorsum either grass green or yellow-green and usually with brown spots. Posterior aspect of thighs pale buff coloured. Upper lip creamy yellow, especially on posterior half, the light colour extending to the edge of the lip, as is usual in Bornean and Malayan populations (Inger 1966).

REMARKS: The entire series was collected between the 18th and 25th February when females contain enlarged pigmented ova and males were calling. In Borneo the breeding period extends at least from April to September (Inger 1966). In eight of the adult males the nuptial pad covers the medio-dorsal area of the base of the first finger, in the remainder the pad is less well developed and is partially or wholly divided into two.

RANGE: The subspecies *raniceps* occurs in W. Malaysia and Borneo, and possibly also Sumatra and peninsular Thailand (Inger 1966).

Rana hosii Boulenger

Rana hosii Boulenger 1891 : 290.

MATERIAL: BM 1967.2460–80, 1967.2481–88 (7 ♀, 21 ♂).

HABITAT: All the specimens were obtained from boulders in the clear, fast flowing stream at Base camp, 700 ft, or from its banks and overhanging branches.

COLOUR IN LIFE: The colour was very variable, the dorsum and flanks of some specimens being uniform grass green, of others olive green or green spotted with brown or brown spotted with green. The backs of the thighs were marbled dark green and brown; the tympanic area and the dorso-lateral fold dark brown. The upper lip and the spot at the jaw angle were yellow and the iris golden yellow.

RANGE: Thailand, W. Malaysia, Sumatra, Java and Borneo.

Rana laticeps Boulenger

Rana laticeps Boulenger 1882 : 20.

MATERIAL: BM 1967.2390–2420 (males, females, halfgrown & juveniles.

HABITAT: All specimens were obtained in aquatic situations under forest from 600–3400 ft. Examples would invariably be found at night in quiet shallow pools at the edges of streams, lurking between stones or under wet fallen leaves and twigs.

Occasional individuals, usually females or immature specimens, were taken from crevices in rotten logs, from the clay banks of streams or from the gravelly stream bed. When disturbed *laticeps* either rapidly swims away or remains motionless, if in water lying with only the eyes protruding from the surface. The wide, fast-flowing stream at Base camp harboured this species only in a restricted area where the current slackened at the margins and shallow (less than 3″ deep) gravel-based pools formed. At higher elevations examples were found at night in rock pools in a steep and exceedingly wet area after prolonged rains, about 20 yds from a fall of water in a narrow stream in the valley below camp 2.

Call: The male calls from water, its head and upper jaw above the surface. The gular skin inflates and pulsates as the soft, melodious gargling sound, which goes up the scale, is uttered. Since no vocal sacs are present in this species it is presumed that when the male calls air that is being shunted to and fro to the buccal cavity causes distention of the loose plicate lining to the floor of the mouth and thus inflation of the gular skin. The mating call was recorded and males responded readily to the play back.

Colour in life: The corrugated upper surfaces were generally orange-brown with darker brown interorbital bar, paired blotches on the middle of the back, lip spots, diagonal temporal band and crossbands on the limbs. Gular region mottled brown and white in females and immature individuals, paler and more greyish in males; belly grey/white. Undersurfaces of hind limbs in all but juvenile frogs vivid orange. None of the examples had yellow on the chest, belly or ventral surfaces of the legs as reported by Inger (1966) as occurring in Bornean examples.

Remarks: Eleven females with enlarged ova range in size from 36·9–42·0 mm (M = 39·7). Males in which the testes are apparently ripe and the mandibular odontoids well developed and sharp vary from 34·7–45·4 (M = 41·9 N9); none has any trace of a nuptial thumb pad.

Range: Assam to Thailand, W. Malaysia, Borneo (Sarawak).

Rana limnocharis limnocharis Wiegmann

Rana limnocharis Wiegmann in Meyen 1835 : 255.

Material: BM 1967.2492–99, 1967.2578 (3 ♀, 6 ♂).

Habitat: This species was found only in the cleared areas at Base camp, 700 ft.

Range: From Ceylon and India to Taiwan and Japan, also W. Malaysia, Singapore, Sumatra, Java, Borneo and the Lesser Sundas as far as Flores.

Rana luctuosa (Peters)

Limnodytes luctuosus Peters 1871 : 579.

Material: BM 1967.2371–77 (4 ♂, 3 gravid ♀, 1 larva).

Habitat: All the examples were taken in or near flooded ruts on the logging tracks in disturbed forest between 700 and 1950 ft.

Colour in life: Head and back rich chocolate brown bordered by narrow cream dorso-lateral line which extends from tip of snout along canthus, edge of upper eyelid to above the vent. Sides of body black. Limbs crossbarred pale grey and black; back of thighs black spotted with white. Ventral surfaces light grey. Flower's (1896) colour plate of this species closely resembles the Benom specimens.

Remarks: The size of the males (S–V 39·3–42·9 mm) and the absence of stripes on the undersurfaces of the limbs of this Benom series confirm Inger's (1966) statement that Malayan examples of *luctuosa* are not only smaller but lack the limb pattern of Bornean populations. The four males appear to be sexually mature and have well developed humeral glands which vary in length from 2·9–3·9 mm. The females with enlarged unpigmented ova measure 46·5, 47·9 and 51·7 mm.

The dental formula in the larva, which has hind limbs well developed, is $\frac{5-5}{1-1:\text{III}}$.

The division of the outermost rows on the upper lip may be due to damage.

Range: W. Malaysia (Penang, Perak, Pahang and Selangor States), Borneo (Sarawak and W. Sabah).

Rana miopus Boulenger

Rana miopus Boulenger 1918 : 11.

Material: BM 1967.2421–2 (2 gravid ♀).

Habitat: Both frogs were found on the main logging track within ½ mile of Base camp at a point where there is considerable secondary growth and wild bananas flanking the track at ca 750 ft.

Colour in life: Upper surfaces orange-red, the dorso-lateral folds somewhat lighter. The post tympanic diagonal band, the spots in the groin as well as the streaks on the haunches adjacent to the dorso-lateral folds black. Back of thighs marbled black and grey. Legs with grey brown crossbars. Diagonal streaks across back also grey-brown.

Range: Known only from the type locality in the southern part of peninsular Thailand, from one specimen obtained in the Chikus Forest Reserve, Perak and from individuals taken in Kelantan and in north, central and southeast Pahang, W. Malaysia.

Rana nicobariensis (Stoliczka)

Hylorana nicobariensis Stoliczka 1870 : 150.

Material: BM 1967.2725 (1 ♀), BM 1967.2389 (1 juvenile).

Habitat: The female was collected at Base camp, 700 ft, in the large camp clearing in disturbed rainforest, while the juvenile was found on the wide track leading to the camp.

Colour in life: No colour notes were made on the adult. Since at the time the frog was collected it was assumed to be another *Rana chalconota* it is likely that the

colour in life was similar in the two species. The upper lip of the juvenile pale green; iris reddish brown.

Remarks: Although this species superficially resembles *Rana chalconota raniceps*, in Benom individuals there is a marked difference in the size and proportions of gravid females, the *nicobariensis* specimen measuring only 46·8 mm in body length while the four adult females of *chalconota* (obtained within 200 yds of the *nicobariensis*) varied from 49·6 to 55·7 mm, average 52·9 mm. Inger (1966) however reports no size difference between the species in Bornean populations, the size ranges for long series of females being 46·5–53·2 mm in *nicobariensis* and 46·0–59·4 mm in *raniceps* with means 50·11 ± 0·44 and 50·68 ± 0·51 mm respectively. With only one example of *nicobariensis* it is unwise to draw any definite conclusions on Pahang populations. The most reliable distinguishing feature between the two species is the considerably less webbing in *nicobariensis* (see figures in Inger 1966).

Range: Peninsular parts of Burma and Thailand, W. Malaysia, Sumatra, Java, Borneo to Bali and Philippines (Palawan).

Rana plicatella Stoliczka

Rana plicatella Stoliczka 1873 : 116.

Material: BM 1967.2362–70 (2 ♂, 7 juveniles).

Habitat: One of the adult males was found on the bank above a soft muddy area with standing water, close to a rivulet that had little current and joined the left bank of the River Kerau tributary 200 yards further on. The other male was said to have come from the same area, about 300 yds downstream from Base camp and at approximately 700 ft.

Colour in life: Upper surfaces mid-chestnut brown with darker brown glandular ridges and with dark crossbars on the limbs. One adult with a cream vertebral band. Throat white, chest and belly sulphur yellow, undersurfaces of hind limbs yellow speckled with brown.

Range: Thailand south of Yala Province, W. Malaysia.

Rana signata signata (Günther)

Polypedetes signata Günther 1872 : 600.

Material: BM 1967.2378–88 (10 ♂, 1 ♀).

Habitat: On Benom *Rana signata* seems to be limited to the lowland rainforest at 700 ft where it occupies a very restricted niche by secondary growth close to the fast flowing tributary of the River Kerau. A distinct preference was shown for a steep mud bank above a still backwater. The backwater, approximately 20 × 12 ft with clear water and a soft mud base, was about 3 ft deep and overhung by branches. At one end where there were large boulders sprayed by the force of the stream *Amolops larutensis* occurred and at the base of the boulders, close to the water,

Bufo asper was common. The males of *signata* were always on the bank 6–12″ above the water calling from the ground but exceedingly difficult to locate by their call as they seem to throw their voices. The call is like a laugh, ha-ha-ha-ha-ha repeated quickly and quietly. Higher on the bank and closer to the forest litter and bases of trees and bushes or on branches of the trees overhanging the backwater males of *Rana chalconota* occurred and I agree with Inger (1969) that *chalconota* has stronger arboreal tendencies than *signata* for nowhere did I witness any evidence of *signata* having even partial arboreal habits. The only adult female that was obtained was collected by a porter at night from the 'stream area at Base camp'; no further data are available.

Colour in life: Dark brown or blackish on upper surfaces with pale apple green or cream spots and blotches on the dorsum and backs of thighs. The limbs with orange coloured cross bars, the bars often broken up into spots. From the tip of the snout, along the canthus and the edge of the upper eyelid an orange line extended dorso-laterally to the groin. In all the examples there is at some point a break in the dorso-lateral line.

Secondary sex characters: Similar to those described by Inger (1966) for Bornean populations and no geographical variation in size seems to occur.

Range: Peninsular parts of Thailand, W. Malaysia (Pahang and Kelantan), Sumatra and Borneo.

Rana tweediei Smith

Rana tweediei Smith 1935 : 62.

Material: BM 1967.2358–61 (2♀, 1 halfgrown ♀, 1 ♂).

Habitat: All were obtained in muddy areas under forest close to small streams, between 700 and 2500 ft.

Colour in life: Dorsum grey and dark brown, the grey being more or less confined to a broad band between the front halves of the upper eyelids, to paravertebral longitudinal streaks, to the sides of the body, to limb cross bars and to vertical streaks on the upper lips. The rest of the upper surfaces were brown, the dorso-lateral glandular folds and interorbital bar rather darker brown. Belly lemon, undersurfaces of thighs and tibia vivid orange, throat white, mottled with brown. A vertebral line similar to that present in the type occurs in the male but is absent in all the females. In life this line was whitish, not yellow as in Smith's (1935) description of the type. The sexes do not differ in their colours in life.

Remarks. The two adult ♀♀, S–V 39·9 and 41·8 mm, have enlarged ova with heavily pigmented poles. They are apparently the first females of this species to have been collected. The sexually mature ♂, S–V 41·1 mm, has, like the type, no secondary sexual characters. No size difference in the sexes occurs and the only external feature that may distinguish them is the male's vertebral band, the fine white line on the hind limbs which in the Benom specimen is restricted to the heel and tarsus, and a greater number of tubercles on the back and limbs (see below).

The series has been compared with the holotype and paratypes and agreement is close. Although Smith mentioned the presence of tubercles on the upper eyelids of the holotype he omitted any reference to similar white tipped tubercles above the vent, on the haunches and especially on the hind limbs; such tubercles occur on these areas in both the type series and in all the Benom material but are less well developed in the females. Additional characters omitted by Smith but present in all examples are a feeble transverse groove on the head, immediately behind the dark interorbital bar, and one to three white spots along under-surface of forearm.

Range: Previously known only from the type series (near R. Yum, Headwaters of R. Plus, E. Perak, W. Malaysia).

Family **RHACOPHORIDAE**

Philautus aurifasciatus (Schlegel)

Hyla aurifasciatus Schlegel 1837 : 27.

Material: BM 1967.2620–57 (10 ♀, 25 ♂, 3 juveniles).

Habitat: This species was seen and heard only between 3400 and 5000 ft. Specimens were collected mostly at night. They were never more than 5 ft from the forest floor, generally on the leaves of small palms or other low plants and bushes. In the valley below camp 3 it was the most common species especially on and at the sides of the wide boulder strewn stream bed.

Colour in life: There was marked individual variation both in pattern and in the shades of brown on the dorsum. A dark chocolate brown interorbital bar was generally evident. Some individuals have a bold dark brown H-shaped mark on the back and on each side of the cross bar of the H a roundish dark brown blotch. Other individuals have a khaki coloured mid dorsal band which extends from the tip of the snout, covers the entire upper surface of the head, narrows behind the eyes and passes back to the vent. A thin, dark vertebral line or a broader, dark brown vertebral stripe may also be present. Yet other individuals have only remnants of the H-shaped dorsal pattern, usually a pair of dorsolateral dark streaks and occasionally in addition the anterior dark blotch. The sides of the body and head were reddish brown with light spots on the haunches, groin, front and back of the thighs and on the undersurface of the tibia. Upper surfaces of the hind limbs crossbarred in dark brown. Ventral surfaces mottled greyish brown, especially on the throat.

Remarks. These specimens have been compared with the syntypes of *Ixalus petersi* Boulenger, considered by Inger (1966) to be conspecific with *aurifasciatus*, and with the syntypes of *Ixalus larutensis* Boulenger which Smith (1930) placed in the synonymy of *I. petersi*. It is not clear from Inger's account of *aurifasciatus* whether he accepted Smith's 1930 concept of *Philautus petersi*. Inger (1966) concluded that a conically tipped snout in *aurifasciatus* is a highly variable character that may or may not be developed in material from Borneo and Java, even in specimens from the same locality. In the G. Benom examples, the conical tip is more

often present and better developed in mature females than in males. A lingual papilla is generally present in both sexes. The outer edge of the fifth metatarsal and of the fifth toe bear a narrow crenulated fringe.

SECONDARY SEX CHARACTERS: The Malayan examples are slightly larger at sexual maturity than the Bornean populations reported on by Inger (1966). The seven gravid females in the G. Benom material vary in body length 31·0–36·7 mm (average 33·6) and 25 males that have a nuptial pad developed measure 20·6–26·2 (average 23·8). The means of the body lengths of Bornean adults are 29·85 (♀♀) and 21·78 (♂♂).

RANGE: From Thailand and Cambodia to Java, Borneo and the Philippines (Inger 1966).

Philautus vermiculatus Boulenger

Ixalus vermiculatus Boulenger 1900 : 187.

MATERIAL: BM 1967.2658–61 (4 ♂).

HABITAT: On rattan and branches of trees in neighbourhood of camp 4 at 5000 ft. This species calls only from high up in the trees. The call crack-crack-crack-crack was heard at several points but the frogs were difficult to locate and collect.

COLOUR IN LIFE: The dorsum of two adult specimens was brown and fawn, the forearm, belly, thighs and flanks golden yellow or orange. The thighs of one individual were spotted yellow and brown. The smallest specimen had a green dorsum with an irregular brown hour-glass pattern and a yellowish throat. Iris silver-grey.

REMARKS: This species was described as having a smooth dorsum (Boulenger 1900b) but examination of the type and of the type of *Ixalus brevipes* Blgr. with which it was synomymized shows that both have small warts scattered over the upper surfaces, especially on top of the snout, above the supratympanic folds and on the heels. The G. Benom specimens also have warts, these being especially prominent on the upper eyelids, shoulders and tibias. Additional distinguishing features are the strongly oblique lores and flaring lips, the curved canthus, and the internarial distance greater than the distance between the naris and the anterior border of the eye and between two and three times the tympanic diameter (in adults twice). In the type as well as in the G. Benom examples the diameter of the third finger disk is consistently greater than the tympanic diameter and not subequal as stated by Boulenger (1900b).

The four Benom examples vary in pattern from the symmetrical markings typical of *brevipes* (Boulenger 1908) to close vermiculations. A light line between the anterior halves of the upper eyelids and two oblique light lines from below the eye to the upper lip are constant. Pigmentation of the groin and of the front of the thighs is absent.

RANGE: Thailand and W. Malaysia.

Rhacophorus appendiculatus (Günther)

Polypedetes appendiculatus Günther 1858 : 79.

Material: BM 1967.2503 (1 ♂).

Habitat: The specimen was found at night 6 ft from the forest floor on a tree in an area of secondary growth at the side of a track close to Base camp at 700 ft.

Colour in life: Dorsum mottled light brown. Thighs pinkish orange on both anterior and posterior surfaces. Throat and belly yellow.

Remarks: In all characters except snout shape this individual closely resembles the type of *Rhacophorus chaseni* (Smith 1924a) which Inger (1966) considered a synonym of *R. appendiculatus*. Like *chaseni* it has below the vent a pronounced transverse dermal flap with crenulated border interrupted on the midline, and from the heel to the 5th toe and also along the forearm to the 4th finger continuous scalloped fringes. There is a scalloped seam too along the lower edge of the lower jaw. But while there is a small dermal projection at the tip of the snout it is very much less pronounced than in the gravid female holotype of *chaseni*. Additional Malayan examples may show that there is a sexual difference in the development of this appendage. The webbing on the toes of the holotype of *chaseni* does not extend to the disks, as described and shown in pl. 1 fig. 1 (Smith 1924a); instead, on the inner aspect of the second, third and fourth toes the web reaches only the distal subarticular tubercles and in this respect agrees with the G. Benom example.

Range: W. Malaysia, Sumatra, Borneo, Philippines.

Rhacophorus colletti Boulenger

Rhacophorus colletti Boulenger 1890 : 36.

Material: BM 1967.2504 (1 gravid ♀).

Habitat: The specimen was collected at night on a leaf on the ridge E.S.E. of Base camp at about 800 ft. A *Cyrtodactylus marmoratus* was obtained on the same tree.

Colour in life: Dorsum uniform pinkish brown.

Remarks: The specimen agrees well with Inger's (1966) excellent description of the species except for the absence on the dorsum of the dark hour glass-shaped figure which apparently is usually present in Bornean and Thai examples.

Range: Extreme southern States of Thailand, W. Malaysia (Pahang), Sumatra, Borneo and islands in the South China Sea.

Rhacophorus leucomystax leucomystax (Boie)

Hyla leucomystax Boie in Gravenhorst 1829 : 26.

Material: BM 1967.2534–77, 1967.2579–89, 1967.2590–619 (27 ♀, 57 ♂, 1 immature).

HABITAT: 600–1950 ft in both primary and secondary forest. The species was particularly common on stems of plants up to 7 ft from the ground, in flooded ditches and in temporary pools between 600 and 1700 ft around clearings and in other areas of disturbance associated with logging. Above 1700 ft specimens were found only on bushes flanking the track.

RANGE: The nominate form occurs from Tenasserim through Thailand to Hainan and northern Vietnam and in W. Malaysia, Singapore, Sumatra, Java, Borneo and the Philippines.

Rhacophorus macrotis Boulenger

Rhacophorus macrotis Boulenger 1891 : 282.

MATERIAL: BM 1967.2533 (1 ♂).

HABITAT: No information other than 'Base camp area, 700 ft'.

COLOUR IN LIFE: The ground colour of the upper surfaces was brick red, with a pair of darker spots between the eyes forming an interorbital bar interrupted medially; other median dark spots on the back. From behind the eye to the flanks a striking dark, almost black horizontal band which covers the tympanum and tapers slightly behind the arm; the band is bordered below by a cream line. A fine white line extends along the outer edge of the forearm and hand. A fine, white line above the vent; two white tubercles below the vent. Flanks marbled. Hind limbs with dark cross bars above. A prominent dark heel patch. Venter whitish, the belly finely speckled.

REMARKS: In the field this specimen was mistaken for *Rhacophorus leucomystax*, two *leucomystax* having a similar brick red dorsum and a somewhat similar appearance, but a closer examination revealed not only that this specimen is much larger than male *leucomystax* (S–V 60·5 mm) but that it has a sharper canthus, more vertical loreal region and more widely flaring lips, less finger webbing and more extensive toe webbing and in other characters too closely resembles *R. macrotis* which was not known to occur in the Malayan peninsula.

RANGE: W. Malaysia, Sumatra, Borneo, Natuna Is., Philippines (Palawan and Sulu Archipelago).

Rhacophorus nigropalmatus Boulenger

Rhacophorus nigropalmatus Boulenger 1895 : 170.

MATERIAL: BM 1967.2505–21 (3 ♀, 14 ♂).

HABITAT: On Gunong Benom the habitat and altitudinal distribution of this species closely paralleled those of *Rhacophorus prominanus* and *R. reinwardtii*. All these species were obtained from flooded, muddy ruts and other temporary pools on the main track, as well as from branches overhanging the pools, in forest between 700 and 1650 ft approximately, but *R. nigropalmatus* showed a preference for higher trees, bushes and palms and seem called from greater heights.

CALL: A loud, clear, teuk-teuk-teuk-teuk which somewhat resembles the tapping of a woodpecker.

COLOUR IN LIFE: Grass green granular upper surfaces with minute white tubercles and occasionally also large, white blotches on the head and hind limbs. Flanks, inside of thighs and undersurfaces yellow. Finger and toe web jet black except for the distal margins which were yellow finely streaked with black. Upper surfaces of toes 1–4 yellow. Iris white.

RANGE: Peninsular parts of Thailand, W. Malaysia, Sumatra, Borneo.

Rhacophorus prominanus Smith

Rhacophorus prominanus Smith 1924 : 185.

MATERIAL: BM 1967.2530–32 (3 ♂), BM 1967.2662–4 (3 larvae).

HABITAT: On branch overhanging puddle in track and in flooded ruts in the track at 800 ft, 1300 ft and 1650 ft.

COLOUR IN LIFE: Upper surfaces of the body and limbs a soft blue-green with small brown spots; belly yellowish. Web between the fingers yellowish, toe web blood red between the 3rd and 4th and 4th and 5th toes. Iris pale buff, heavily streaked with red.

LARVAE: Three premetamorphic tadpoles at stages XI–XVII, obtained from a pool on a logging track at ca 900 ft are tentatively assigned to this species. Their size, very broad feet with full web extending to the toe disks suggests that they belong to the *nigropalmatus*, *prominanus*, *reinwardtii* group. Their dental formula, however, does not agree with that given for *nigropalmatus* (Inger 1966) and the unpigmented webbing on the toes makes assignment to *reinwardtii* unlikely. A composite description of the three G. Benom tadpoles is as follows: body ovate, flattened above and below; eyes dorsal, not visible from below; diameter of eye subequal to eye–nostril and 4/5 internarial distance, 2/3–1/2 the interorbital distance; spiracle sinistral, not tubular, below line connecting eye to root of hind limb, slightly nearer eye than root of hind limb; anus dextral, opening not reaching margin of ventral fin. Mouth ventral, subterminal; beaks black-edged, finely serrate, upper one a smooth arc; papillae small and homogeneous, continuous along lower lip and in 3–4 rows, confined to lateral corners of upper lip; dental formula I: 6–6/ 1–1: II; very narrow gaps between the two outermost divided rows of upper lip and the divided row of lower lip. Tail 0·54–0·6 of total length, weakly convex, deeper than body at centre, abruptly tapering in last quarter to slender, rather blunt tip; dorsal fin only very slightly deeper than ventral fin and both narrower than caudal muscle at centre. Colour in alcohol of head and body pale greyish brown above, white below, without pattern; tail fins pale grey, caudal muscle yellowish, without pattern.

RANGE: Peninsular parts of Thailand, W. Malaysia, Nias Is., ? Sumatra.

Rhacophorus reinwardtii (Wagler)

Hypsiboas reinwardtii Wagler 1830 : 200.

MATERIAL: BM 1967.2522–29 (7 ♂, 1 ♀).

HABITAT: On Gunong Benom this species occurs in similar areas and in somewhat similar habitats to *Rhacophorus nigropalmatus* and *R. prominanus*. It is a lowland species and was never seen or heard above 1600 ft yet the G. Benom examples appear to be the first record of the species from Malaya. Specimens were found on the wide logging track in depressions caused by tyre tracks and flooded by rains and in other temporary pools by secondary growth in disturbed forest and near to banana stands, as well as up to 12 ft from the ground on banana fronds, bamboo and bushes that overhung pools.

CALL: *R. reinwardtii* calls from bushes, often bamboo, and from a lower level than *R. nigropalmatus*. Its call is a rat-tat-tat resembling a rattle or a woodpecker's tapping and is softer and quieter than the call of *R. nigropalmatus*.

COLOUR IN LIFE: Dorsum and upper parts of the limbs a soft apple green, sides of body brick red with large, black areas, marbling and spots all of which were outlined with sky blue. Inner surfaces of the arm, of the tibia and to a lesser extent of the tarsus black with pale blue spots. Posterior aspect of thighs grey with very fine black reticulations. Undersurfaces of throat and belly pale yellowish grey or chalky white with black marbling. Iris white. Web between all the toes and all the fingers from base to distal margin intense black with sky blue spots and streaks on both the upper and lower surfaces. Except for the outermost, the fingers and toes were similarly coloured.

REMARKS: While these specimens agree with *reinwardtii* and differ from *bimaculatus* Blgr. in the extent of the web on both fingers and toes, in the tympanic and finger disk sizes and proportions, in head proportions and in the development of dermal appendages (Inger 1966) they exhibit marked differences in size from the Javan and Sumatran populations of *reinwardtii*, and in colour pattern are unlike Javan *reinwardtii* although they show certain resemblances to the var *lateralis* described and figured by Werner (1900) from a single individual obtained at Batu Bahru, Sumatra (Basel Museum 1192). The G. Benom males vary in body length from 59–66 mm (average 63 mm) and the female measures 80·3 mm. Inger (1966) gave a range of 46–55 mm for mature male *reinwardtii* while Wolf (1936) recorded 56 mm for males and 76 mm for females. Five examples of *reinwardtii* obtained in Java and in the British Museum collections have body lengths of 52 mm (3 ♂♂) and 70 and 71 mm for the two females. As can be seen from the description of colour in life, in the G. Benom sample black pigmentation was much more extensive than in Javan populations of *reinwardtii* (Schlegel 1844 plate 30, fig. 4, Van Kampen 1923, fig. 28) and in none of the Malayan examples is the black pigment on the finger and toe web restricted to large black spots between the second and third and third and fourth fingers and between all the toes except the first and second, as occurs in Javan *reinwardtii*.

RANGE: W. Malaysia (Pahang), Sumatra and Java.

SAURIA

Family AGAMIDAE

Aphaniotis fuscus Peters

Otocryptis (*Aphaniotis*) *fusca* Peters 1864 : 385.

MATERIAL: BM 1967.2837–39.

HABITAT: The specimens were found at 700 ft and 2700 ft. No further information on their habitat is available.

RANGE: Peninsular parts of Thailand, W. Malaysia, Borneo, Natuna Is.

Goniocephalus borneensis (Schlegel)

Lophyurus borneensis Schlegel 1848 : 6.

MATERIAL: BM 1967.2840–41 (2 ♂).

HABITAT: The smaller specimen was found on a bush in disturbed forest near Base camp, 700 ft, the larger was caught by a dog near the track in the forest at 1900 ft.

COLOUR IN LIFE: The throat pouch had on each side a vivid pink patch surrounded by bright ultramarine blue. The base of the pouch was yellow green. The trunk was greyish green dorsally with brown edged ocelli on the flanks. Tail black and cream banded.

RANGE: Peninsular parts of Thailand, W. Malaysia, Borneo.

Draco fimbriatus fimbriatus Kuhl

Draco fimbriatus Kuhl 1820 : 101.

MATERIAL: BM 1967.2798–800 (1 ♀, 2 ♂).

HABITAT: The larger of the two males (107·3 mm) was found lying apparently stunned on the verandah of a hut at 700 ft in the forest clearing in early morning. The other male (104·8 mm) was obtained at ca 1900 ft on the ridge southwest of camp 2. The female (101·8 mm) was shot on a tree at 35 ft from the ground in disturbed forest. The tree, 18" in diameter and at the side of the logging track between Base camp and Kampong Damak at ca 600 ft, had *Draco volans* and *D. punctatus* on it as well, but at a lower height from the forest floor.

COLOUR IN LIFE: The general appearance and colouration of the upper surfaces of this species were of rough bark in shades of grey, black, brown and reddish brown. The wing membranes were indistinctly longitudinally striped black and greyish brown above; their lower surfaces were orange with black spots (♀) or light grey with dark brown spots (♂). In the female the belly, undersurfaces of the base of the tail and of the thighs were orange, the throat pale grey mottled with darker grey and the gular appendage and wattles coral pink. The males had similarly coloured dewlaps and wattles and there were also coral spots on the cheek, chin,

and sides of the head. Rather duller orange marks were present on the vertebral region of the large male.

RANGE: Southern provinces of peninsular Thailand, W. Malaysia, Singapore, Gt. Natunas, Sumatra, Java, Borneo.

Draco formosus formosus Boulenger

Draco formosus Boulenger 1900 : 190.

MATERIAL: BM 1967.2801–26 (5 ♀, 19 ♂, 2 juveniles).

HABITAT: The altitudinal range of this species on G. Benom is 700–2500 ft but above camp 2 (1700 ft) it was very rarely seen and only five of the series were obtained from above 1800 ft. All specimens were on trees at heights varying from 8–20 ft from the forest floor. *D. formosus* was more closely associated with the trees skirting the camp clearing and the wide logging tracks than other Dracos and was the commonest species of *Draco* in the area.

COLOUR IN LIFE: Head and body brown above with obscure darker markings. A dark brown transverse band across the upper eyelids and a median dark brown interorbital spot present in both sexes. A pair of jet black spots on the occiput and a pair of more widely separated dark spots farther back on the neck constantly present in the males. Wing membranes mostly yellowish above with five black, somewhat wavy transverse lines, the bands narrower than the interspaces, the distal portion of the wing maroon. Lower wing surfaces similar in colouration but the bands often indistinct. Gular pouch thin and translucent, a whitish grey. Throat and undersurfaces of the wattles blood red. Chin grey with dark reticulations.

REMARKS: The females which contain three or four, usually four, large, broadly oval eggs vary in snout to vent length 74·8–87·6 (average 80·0 mm). Males vary in length from 80·4–102·7 (average 93·7 mm).

RANGE: The nominate form is said to be restricted to S. Thailand and W. Malaysia (Hennig, 1936, Taylor 1963).

Draco maximus maximus Boulenger

Draco maximus Boulenger 1893 : 522.

MATERIAL: BM 1967.2828 (1 ♂).

HABITAT: On tree flanking logging track at ca 800 ft at junction of the track between Base camp and K. Damak and the path leading to camp 2.

RANGE: W. Malaysia, Gt. Natunas, Sumatra, Borneo.

Draco melanopogon Boulenger

Draco melanopogon Boulenger 1887 : 492.

Material: BM 1967.2830–34 (2 ♀, 3 ♂).

Habitat: All specimens were shot in trees among secondary growth flanking the logging tracks and the trail to the stream below Base camp and between 600 and 1000 ft.

Colour in life: Head and vertebral region brown becoming green on the sides of the trunk. Upper surfaces of limbs greenish brown. Some indistinct dark brown cross bars and spots across head and back. Wing membranes black with numerous yellow spots on both upper and lower surfaces. Gular pouch yellowish green in the female, jet black in the male; wattles white in both sexes. Throat, chest and undersurface of forelimbs orange in the male; undersurface of tail similarly coloured.

Remarks: The two females captured 23/24th February are gravid. One measuring 82 mm snout–vent contains only one oviducal egg, 8·0 mm long, the other individual, 79 mm, has the normal *melanopogon* complement of two, each 5·5 mm in length (Inger & Greenberg 1966). The eggs are almost spherical and not distinctly pointed as described by Hendrickson (1966).

Range: Thailand south of the Isthmus of Kra, W. Malaysia, Gt. Natunas, Sumatra, Borneo.

Draco punctatus Boulenger

Draco punctatus Boulenger 1900 : 189.

Material: BM 1967.2828 (1 ♂).

Habitat: The specimen was taken 25–35 ft from the forest floor on a tree near the main logging track at ca 600 ft. In the same tree simultaneously were two other species of *Draco, fimbriatus* and *volans*.

Colour in life: The upper surfaces of the head, body and limbs grey and brown with scattered dark brown speckling. Wings reddish brown above, longitudinally streaked with light grey. Gular pouch pale grey at base, brilliant yellow towards apex, chin yellow spotted grey. Wattles intense lemon yellow. Undersurfaces of the trunk grey-green, of the wings greyish yellow with scattered black spots.

Range: Southern provinces of peninsular Thailand, W. Malaysia, Sarawak.

Draco quinquefasciatus quinquefasciatus Hardwicke & Gray

Draco quinquefasciatus Hardwicke & Gray 1827 : 219.

Material: BM 1967.2829 (1 ♀).

Habitat: Shot on 6″ diameter tree, 10 ft from the forest floor, on the ridge at ca 800 ft NNE of Base camp at noon on 25 February. The individual is gravid and contains four well matured oval eggs, the largest 15·7 mm long.

COLOUR IN LIFE: Ground colour of body yellow-green with broad greyish black cross bands. Wings above orange-red with five broad black cross bands, each with a single row of small white spots confluent with those of the trunk, the orange becoming yellowish medially. Throat green, speckled brown, the wattles black at their bases with a white band, yellowish anteriorly. Gular appendage yellowish orange, belly cream. Undersurfaces of wings yellow becoming orange laterally and posteriorly, with five broad black bands each of which bordered by greyish green, the most posterior band short and not extending to the lateral wing margins.

RANGE: Extreme southern provinces of peninsular Thailand, W. Malaysia.

Draco volans volans Linnaeus

Draco volans Linnaeus 1758 : 199.

MATERIAL: BM 1967.2835–36 (1 ♀, 1 ♂).

HABITAT: The female which contains three large (13·4 mm) eggs was seen on the ground in the kitchen quarters of Base camp 700 ft. When disturbed it ran up a low leafy tree and was shot. The male was found 25–35 ft from the forest floor on a tree near the main logging track at ca 600 ft. On the same tree and at the same time *D. f. fimbriatus* occurred but at a greater height, and nearer the ground an example of *D. punctatus* was obtained.

COLOUR IN LIFE: Above, the head, body and wings in both sexes were brown and grey, the grey on the back forming discreet transverse series of spots and lines which extended to the wings. There was a dark brown interorbital spot and in the female a dark medial nuchal spot. The gular pouch in the female was a vivid turquoise blue, in the male brilliant yellow, speckled black at its base. The inner surfaces of the wattles were greyish white. The eyelids in the male were sky blue. The undersurfaces of the trunk and limbs were pale greenish blue medially and yellow-green on the sides (♀) or powder blue (♂). In the female the undersurfaces of the wings were vivid yellow with black interrupted transverse lines and spots, while those of the male were powder blue with black interrupted transverse wavy bands.

RANGE: Peninsular parts of Thailand, W. Malaysia, Singapore, Sumatra, Java, Borneo, Natunas, Philippines (Palawan).

Family **VARANIDAE**

Varanus bengalensis nebulosus (Gray)

Monitor nebulosus Gray in Cuvier 1831 : 27.

MATERIAL: BM 1967.2842 (1 juvenile).

HABITAT: The example was found during late afternoon at the entrance to an elliptical hole 18 ft from the forest floor in a tree by the trail, downstream from Base camp, 700 ft.

RANGE: The subspecies *nebulosus* occurs from S. Burma to S. Vietnam and southwards throughout W. Malaysia and Java.

Varanus salvator salvator (Laurenti)

Stellio salvator Laurenti 1768 : 56.

MATERIAL: BM 1967.2843 (juvenile ♀).

HABITAT: This specimen, which weighed 4 lbs and had a total length of 1450 mm, was obtained from the banks of the stream about ½ mile below Base camp and at about 650 ft. Its stomach contained a mouse deer.

RANGE: The nominate subspecies occurs from Ceylon and India to Thailand, Vietnam and Hainan, W. Malaysia and islands to the south and east as far as northern Australia.

Family GEKKONIDAE

Cnemaspis affinis (Stoliczka)

Cyrtodactylus affinis Stoliczka 1870 : 167.

MATERIAL: BM 1967.2781 (1 juvenile).

HABITAT: Camp 2 clearing, 1700 ft.

RANGE: Southernmost provinces of Thailand, W. Malaysia.

Cnemaspis kendallii (Gray)

Heteronota kendallii Gray 1845 : 174.

MATERIAL: BM 1967.2782 (1 ♀).

HABITAT: On kitchen table at Base camp during afternoon, 700 ft.

RANGE: Thailand, W. Malaysia, Singapore, Gt. Natuna Is., Borneo.

Cyrtodactylus ?brevipalmatus (Smith)

Gymnodactylus brevipalmatus Smith 1923 : 48.

MATERIAL: BM 1967.2783 (1 ♂).

HABITAT: At night on leaf litter of forest floor near Base camp clearing and stream at 700 ft.

REMARKS: The G. Benom example differs from the holotype, from a juvenile also obtained in Nakhon Si Thammarat and from a female collected in Raheng, N. Thailand 2500 ft, in having fewer trunk tubercles and in their being disposed in approximately three longitudinal paravertebral rows that do not extend to the flanks. It further differs from the type in lacking femoral pores and in having only eight preanal pores. The tail is not cylindrical but is noticeably depressed and has almost vertical sides so that in section it is squarish. Tail denticulation appears to be less pronounced in the type but this may be artifact and due to preservation although the pointed tubercles along the dorsolateral edges are certainly shorter

than in the G. Benom example. The toe web, the number of ventral scales at midbody between the lateral folds (44) and the number of the digital lamellae agree with the type and the other examples, but dilation of the basal phalanges appears to be greater. Smith's figure of the toes of *brevipalmatus* (1923, pl. 5) is inaccurate in omitting the plates under the distal portion of the distal halves.

RANGE: Known only from specimens obtained in the Nakhon Si Thammarat Mts., Peninsular Thailand, from Raheng, N. Thailand (Smith 1935), and from the Gunong Benom individual.

Cyrtodactylus consobrinus (Peters)

Gymnodactylus consobrinus Peters 1871 : 569.

MATERIAL: BM 1967.2784 (1 juvenile).

HABITAT: The specimen was smoked out of a hole in a live tree in the valley below camp 2, at about 1600 ft.

RANGE: W. Malaysia and Borneo.

Cyrtodactylus marmoratus (Kuhl)

Phyllurus marmoratus Kuhl in Fitzinger 1826 : 47.

MATERIAL: BM 1967.2785–95 (6 ♀, 4 ♂).

HABITAT: The series was obtained in forest between 700 and 3500 ft. Most examples were found at night on branches and trunks of trees, one being on the undersurface of a large, rotten tree trunk that had fallen across the boulder strewn stream bed in the valley below camp 3, another inhabited a hole between the roots of a 6″ diameter tree close to the camp 3 huts and emerged from its hole soon after dusk to crawl up the trunk. At the lower elevations a few individuals were found on the high bank at the side of the logging track.

REMARKS: These specimens agree well with all the diagnostic characters of *marmoratus* except for the position and number of pores in the males. The male *C. marmoratus* is said to be characterized by both preanal and femoral pores and a longitudinal preanal groove, the preanal pores numbering 12 or 13, the femoral pores 4–6 on each side (Boulenger 1912) but while these G. Benom specimens have a row of enlarged femoral scales none of the scales has a pit or pore and there are, at the most, only five preanal pores in a V-shaped line. They vary in body size from 55·4–61·3 mm.

RANGE: Thailand, W. Malaysia, Sumatra, Java, Borneo, Celebes, New Guinea, Christmas Island.

Gehyra mutilatus (Wiegmann)

Hemidactylus mutilatus Wiegmann in Meyen 1835 : 238.

MATERIAL: BM 1967.2796–97 (1 ♀, 1 ♂).

HABITAT: Both specimens were smoked out of live trees in the forest near camp 2 at 1700 ft.

RANGE: Widely distributed from Ceylon and S. Burma to S. China, Japan, Thailand, W. Malaysia, Indo-Australian Archipelago, Oceania and islands in the Indian Ocean.

Family SCINCIDAE

Lygosoma (Scincella) vittigerum vittigerum Boulenger

Lygosoma vittigerum Boulenger 1894 : 615.

MATERIAL: BM 1967.2854 (1 juvenile).

HABITAT: The specimen, which has a body length of only 17·5 mm, was found during the morning on the bark of a tree close to camp 2 at 1700 ft.

RANGE: Peninsular parts of Burma and Thailand, W. Malaysia, Sumatra, Mentawei Is., Borneo.

Mabuya multifasciata (Kuhl)

Scincus multifasciatus Kuhl 1820 : 126.

MATERIAL: BM 1967.2844–53 (4 adults, 6 juveniles).

HABITAT: This species was the most common lizard in and around camp at 700 ft, invariably frequenting secondary growth. Individuals were obtained from the ground, on and among fallen leaves, on piles of felled branches, on a pile of sand at the edge of the track, as well as apparently asleep on the trunk of a tree.

COLOUR IN LIFE: Taylor's description (1963) of the colour pattern of this species applies equally well to the G. Benom examples but on the chin, throat and chest of one adult male was mustard yellow, the rest of the ventral surfaces being a greyish green. From the tympanum to the flanks this individual was a reddish orange. The lateral ocelli may or may not be clearly marked and the dark brown lateral stripe may or may not be bordered above by a light, longitudinal dorsolateral stripe 1½ scales wide.

REMARKS: The midbody count in these examples is 34(7) and 32(3). The first loreal is usually lower than the second, rarely of similar height. In each specimen the frontonasal forms a suture with the nasal and generally a broad suture. Both the head shields and the dorsal trunk scales have dark streaks at their edges, usually at the posterior borders of the head shields and at the lateral edges of the body scales.

RANGE: From N.E. India to S. China, Thailand, W. Malaysia, Singapore, Sumatra, Java, northwards to the Philippines and eastwards to New Guinea.

Sphenomorphus indicus indicus (Gray)

Hinulia indica Gray 1853 : 388.

MATERIAL: BM 1967.2855 (1 juvenile).

HABITAT: On fallen tree trunk and among dead leaves on peaty ground at 3650 ft during the afternoon.

REMARKS: This individual, and two juveniles obtained at Bukit Fraser which were reported on by Smith (1922b & 1930), differ somewhat from the nominate form of *indicus*. They have a higher midbody count (36) than in both Tennasserim examples (30–32: 32 in the types of *zebratum*) and the average N.W. Thailand specimen (34·3: N 17) (Taylor 1963) and the number of subdigital lamellae on the fourth toe is slightly greater (22–24) than in the adult *zebratum* syntype, in N.W. Thailand examples (18–19) and in the *indicus* types (19 : 20, 18 : 20). Both Smith (1935a) and Taylor (1963) err in stating that the frontal is as long as—or longer (Smith)—than the combined parietals for while this is so in the syntypes of *indicus* and in the adult *zebratum* syntype, in the juvenile *zebratum* syntype and in both the Gunong and Bukit Fraser examples the frontal is 3/4 the distance from its posterior border to the posterior border of the parietals, measured along the midline.

RANGE: From India to central China and southwards to W. Malaysia.

SERPENTES

Family **TYPHLOPIDAE**

Typhlops diardi mulleri Schlegel

Typhlops Mülleri Schlegel 1839 : 32.

MATERIAL: BM 1967.2267.

HABITAT: Among leaf litter at base of tree in Base camp clearing, 700 ft.

RANGE: Tenasserim through Thailand to S. Vietnam, also W. Malaysia, Singapore, Sumatra and Borneo.

Family **NATRICIDAE**

Natrix trianguligera (Boie)

Tropidonotus trianguligerus Boie 1827 : 535.

MATERIAL: BM 1967.2273 (1 ♀).

REMARKS: The specimen was found at night swimming in a still backwater of the stream at Base camp, 700 ft. In life the sides of the anterior half of the trunk were brick red, the upper surface of the head dark olive, the iris light olive. Upper labials and mental pale buff-coloured, venter pale yellowish.

Scale rows	19
Ventrals	139 + 2
Sub caudals	93

RANGE: Peninsular parts of Burma and Thailand, S. Vietnam, W. Malaysia, Singapore, Sumatra, Java, Mentawei Is., Borneo, Celebes.

Amphiesma sarawacensis (Günther)

Tropidonotus sarawacensis Günther 1872 : 596.

MATERIAL: BM 1967.2274–5 (2 ♂).

REMARKS: The two specimens appeared within five minutes of each other on the soft peaty soil behind the log fire in camp 4 (5000 ft) at 1300 hrs. Their colouration was as described by Tweedie (1954) for this species.

	2274	2275
Scale rows	17	17
Ventrals	139 + 2	140 + 2
Subcaudals	77	32+

The gall bladder is situated deep to ventral 50.

RANGE: W. Malaysia, Borneo.

Macropisthodon rhodomelas (Boie)

Tropidonotus rhodomelas Boie 1827 : 535.

MATERIAL: BM 1967.2282 (1 ♂).

REMARKS: Found midmorning on the ground among forest litter at the timber stack at junction between main path from Base camp and track to camp 2.

Scale rows	19
Ventrals	132 + 2
Subcaudals	54

RANGE: Peninsular Thailand, W. Malaysia, Singapore, Sumatra, Java, Borneo.

Family **COLUBRIDAE**

Elaphe flavolineata (Schlegel)

Coluber flavolineata Schlegel 1837 : 141.

MATERIAL: BM 1967.2287 (1 ♀).

HABITAT: On track above camp 2 at approximately 1800 ft.

COLOUR IN LIFE: Body green above, the dorsal scales edged with black, with indistinct yellowish transverse bands on the mid body that became orange farther back and more clearly defined. Ventrals yellow and narrowly edged with black,

underside of tail with broad orange bands, 6–7 scales in length on a greenish ground. Upper labials vivid yellow. A black temporal blotch.

Scale rows	19
Ventrals	236
Subcaudals	116+ (tip of tail missing)
Upper labials	9 5th and 6th entering eye
Temporals	2 + 2

RANGE: Andamans, Peninsular Burma and Thailand, W. Malaysia, Singapore, Sumatra, Java, Mentawei Is., Borneo, Celebes.

Gonyophis margaritatus (Peters)

Gonyosoma margaritatum Peters 1871 : 578.

MATERIAL: BM 1967.2278 (1 ♂).

REMARKS: This specimen was found at about 2750 ft crossing the track between camps 2 and 3. In life it was most beautifully coloured, the upper parts being pale green with the dorsals heavily margined in black and with yellowish, broad cross bands on the posterior two-thirds of the body and tail that became brick red towards the tail. On the undersurfaces of the snake the mental and first and second labials and sides of the snout were orange, the rest of the labials and the throat yellow, the ventrals as far as V34 were also yellow and farther back an orange midventral line developed that became deep orange with blackish cross bars. There was a deep black temporal band.

Scale rows	19
Ventrals	238 + 2
Subcaudals	128
Total length	570 mm

RANGE: W. Malaysia (Perak, Pahang, Kelantan), Borneo.

Liopeltis longicauda (Peters)

Ablabes longicaudus Peters 1871 : 574.

MATERIAL: BM 1967.2268–70 (2 ♂, 1 ♀).

REMARKS: 750 ft. Two of the specimens were found in coitus on the main track leading from Base camp at midday on 21st February. The third specimen was obtained in the same area. All three differ from Tweedie's description (1957) of the species in having the venter from the throat to the tail tip yellow. The chin was white in life and the head and nape markings white.

	2268	2269	2270
Sex	♂	♀	♂
Scale rows	13	13	13
Ventrals	116	114	116
Subcaudals	12+	24 + 1	54+ (tail damaged)

The gall bladder is situated deep to ventral 74 in the male and deep to ventral 79 in the female.

Liopeltis baliodeirus (Boie)

Coronella baliodeira Boie 1827 : 539.

MATERIAL: BM 1967.2271 (1 ♂).

REMARKS: Found during late afternoon at about 1000 ft on the track between Base camp and camp 2. The undersurfaces of the posterior half of the body and all of the tail were orange in life.

Scale rows	13
Ventrals	121 + 2
Subcaudals	72

RANGE: Peninsular Thailand, W. Malaysia, Singapore, Sumatra, Java, Natuna Is., Borneo.

Pseudorhabdion longiceps (Cantor)

Calamaria longiceps Cantor 1847 : 63.

MATERIAL: BM 1967.2272 (1 ♀).

REMARKS: 700 ft. The specimen was dug out of a rotting hollow log in the forest near Base camp. In life the head was a dull blood red, the collar yellowish and the trunk dark brownish red.

Scale rows	15
Ventrals	135
Subcaudals	29

RANGE: Southernmost provinces of Thailand, W. Malaysia, Singapore, Sumatra, Borneo, Celebes and ? Philippines (Taylor 1965).

Family **DIPSADIDAE**

Calamaria lumbricoidea Boie

Calamaria lumbricoidea Boie 1827 : 540.

MATERIAL: BM 1967.2279 (1 ♂).

REMARKS: The individual was found at 21 00 hrs. crossing the earth floor of the kitchen at Base camp (700 ft). The dorsum except for the upper labials is brown and without stripes and most of the body scales have a darker brown apical spot. The lips are cream. The venter has black bars, each bar covering two adjacent ventral scales and separated from the next by a varying number of yellowish scales but usually by 3, 4 or 5. The absence of stripes in this specimen, coupled with a ventral count of 172 and four gulars between the posterior chin shields and the first ventral, agree better with individuals obtained from states on the western side of the peninsula than with Pahang *lumbricoidea* (Inger 1965).

The hemipenis is forked and papillate.

Scale rows	13
Ventrals	172 + 1
Subcaudals	24
Supralabials	6 (3–4)
Temporals	0 + 1

RANGE: Southern Thailand to Java, Borneo and Leyte (Inger 1965).

Lepturophis borneensis Boulenger

Lepturophis borneensis Boulenger 1900 : 183.

MATERIAL: BM 1967.2294 (1 ♂).

REMARKS: The G. Benom individual appears to constitute the first record of the occurrence of *Lepturophis* in the Malayan Peninsula. Previously this monotypic genus was known only from the type obtained in Sarawak and from a subsequent series of twelve in the Field Museum Chicago, from Sabah and Sarawak.

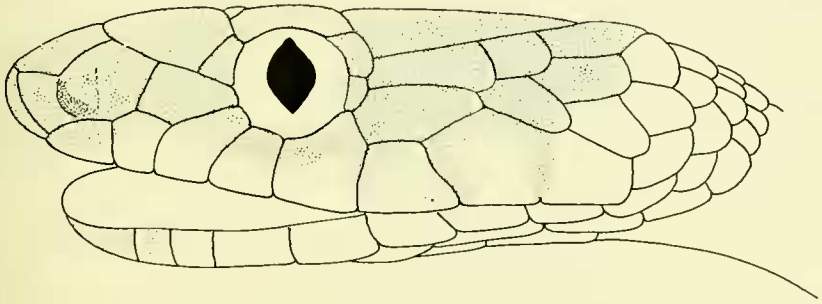

FIG. 2. *Lepturophis borneensis* (B.M. 1967.2294).

Boulenger (1900a) likened the teeth of *Lepturophis* to those of *Lycodon* and gave the formula of the type specimen as 6 + 6. The type specimen has not been examined by me; it is probably in the Kuching museum, Sarawak, but confirmation has not been received. The G. Benom example has been compared with the Field Museum series assigned to *Lepturophis* which in scale counts and in dentition agree favourably with the G. Benom specimen. See table A, p. 47. The only resemblance between the teeth of *Lycodon* and those specimens examined here is in the large fang-like anterior maxillary tooth followed by a diastema then a series of small teeth. In the G. Benom individual the maxillary formula is 6 + 6 + 3, the first six gradually increasing in size, the second group of six being small and of more or less equal size while the posterior group are again fang-like. The left maxilla of FMNH 158650 which was dissected out appears to have a formula of 6 + 3 + 3 but FMNH 148895–6 have series of six small teeth in the centre of the maxillae. These enlarged

rear teeth are of a curious shape; their medial surfaces are flat but on the lateral surfaces flattening is restricted to the anterior and posterior surfaces of the teeth with the central portion of each tooth rounded externally and thus semicircular in transverse section. The flat flanges on the posterior and anterior borders of the tapering teeth give them sharp, cutting edges. Similar lateral compression of the anterior

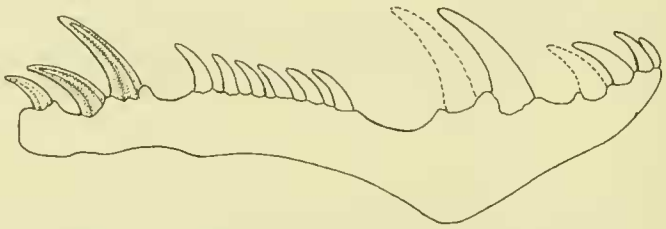

Fig. 3. Maxilla and maxillary teeth of *Lepturophis borneensis* (B.M. 1967.2294).

and posterior surfaces of the maxillary teeth occurs in *Xenopeltis* (Thomson 1913) but in that genus the teeth have blunt tips and a blade-like appearance and moreover are set at an oblique angle to the long axis of the jaw. Lateral compression of the teeth is also developed in *Iguanognathus* which however has spatulate, chisel-shaped teeth with broad tips and of quite a different type. The notched and grooved ventrals, coupled with the extremely slender, elongate body (total length of G. Benom example 167·6 cms) suggest that *Lepturophis* is an arboreal snake, although the Malayan example was found on the ground at night on the main track near Base camp at 700 ft and the Field Museum series was collected in or on the banks of forest streams.

In life the snake was a uniform dark grey dorsally with a whitish venter.

Range: W. Malaysia (Pahang), Borneo (Sabah, Sarawak).

Macrocalamus jasoni sp. nov.

Holotype: BM 1967.2283, a gravid female from leaf litter on track below camp 5 at about 5800 ft, Gunong Benom, C. Pahang, W. Malaysia, collected by John A. Bullock, April 9th 1967.

Paratypes: BM 1967.2284, female, from leaf litter on forest floor of summit knoll above camp 5 Gunong Benom, 6500 ft collected by Lord Medway, March 27th 1967. BM 1967.2285, female, locality as holotype collected by Bah Chung, April 9th 1967.

Description of holotype: Midbody scales in 15 rows, ventrals 131, subcaudals 17. Loreal precisely twice as long as deep, one preocular, one postocular, 1 + 2 temporals, 8 upper and 7 lower labials, the fourth and fifth upper labials entering the eye, the fourth making contact with the loreal. Gall bladder deep to ventral 96, maxillary teeth 11, palatine teeth 11, pterygoid teeth 19. The colour in life was iridescent black on the dorsum with a conspicuous pair of dorsolateral yellow ochre

TABLE A

Scale counts in *Lepturophis borneensis*

Museum No.	Locality	Sex	D	V	C	Upper labials	Lower labials	Postocular	Preocular	Temporals
TYPE	Sarawak	?	17	241 + 2	193	8 (3–5)	(5)	2	1	2 + 2
FMNH 63597	Sabah: Sandakan Dist.	♀	17	238 + 2	179 + S	8 (3–5)§ / 8 (3–6)	9 (5)	2	1	2 + 2 + 2
63598		♀	17	227 + 2	182 + S	8 (3–5)	9 (5)	2	1	2 + 2 + 3‖ or 2 + 2 / 2 + 2 / 2 + 2
138667	Sarawak 3rd Div.	♀	17	230 + 2	113 +	8 (3–5)	9 (5)	2	1	2 + 2 + 2
145709	,, ,,	♂	17	244 + 2	189 + S	9 (3–5)†	9 (5)	2	1	2 + 2 + 2
148893	,, ,,	♀	17	225 + 2	170 + S	8 (3–5)	9 (5)	2	1	2 + 2 + 2
148894	,, ,,	♀	17	230 + 2	174 + S	8 (3–5)	9 (5)	2	1	2 + 2 + 2
148895	,, 4th Div.	♀	17	228 + 2	167‡	8 (3–5)	9 (5)	2	1	2 + 2 + 2
148896	,, ,,	♂	17	243 + 2	203 + S	8 (3–5)	9 (5)	2	1	2 + 2 + 3
148897	,, ,,	♀	17	230 + 2	171 + S	8 (3–5)	9 (5)	2	1	2 + 2 + 3
158649	,, ,,	♂	17	243 + 2	206 + S	8 (3–5)	9 (5)	2	1	2 + 2 + 3 / 2 + 2 + 2
158650	,, ,,	♀	17	229 + 2	176 + S	8 (3–5)	9 (5)	2	1	2 + 2 + 2
158651	,, ,,	♀	17	231 + 2	175 + S	8 (3–5)	9 (5)* / 8 (4)	2	1	2 + 2 + 2
BM 1967.2294	G. Benom	♂	17	247 + 2	185 + ¶	8 (3–5)	9 (5)	2	1+ loreal	2 + 2 + 3

* Left side 3 & 4 fused.
† On both sides another "upper labial" between the 2nd and 3rd is excluded from the mouth.
‡ About 5 or 6 missing.
§ Dorsal origin of suture between 5th and 6th left upper labials obscured by scratches.
‖ Third right upper temporal may be caused by a break in the 2nd upper temporal.
¶ About 7 missing.

stripes which extend from the temporals to the tip of the tail. These stripes which are two scales wide and are separated from each other by three scales are bordered below by black, the black extending from the fourth longitudinal dorsal row of scales to the lateral fifths of the ventral scales. The ventrals, apart from their black lateral margins and medial black flecks on ventrals 1–8 are bright yellow. The subcaudals are yellow except for occasional black speckling at their medial margins.

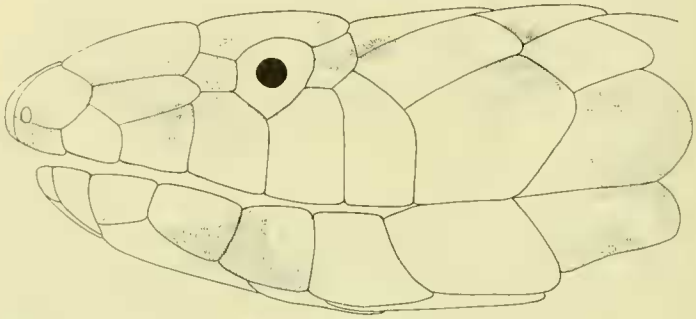

FIG. 4. *Macrocalamus jasoni* Holotype.

The head is brownish yellow with blackish areas on the prefrontals, loreal, pre- and postoculars, anterior temporal and labials, except for the sixth upper labial which is entirely yellow. From the last upper labial to the last lower labial the black colouration forms a broad but rather ill-defined vertical bar. The mental and first lower labials are black and the black extends on to the anterior chin shields where it surrounds a yellowish oval patch on each shield.

Total length 760 mm, midbody girth 237 mm.

VARIATION: The paratypes are similar to the holotype in dorsal colouration and in their stocky build but are considerably smaller in total length (380 mm and 550 mm). Apart from black tips to the outer margins of the ventral scales the undersurfaces of 2285 are a uniform yellow but in 2284 most ventral and subcaudal scales have a medial black patch or streak in addition to the lateral black marks In the paratypes the ventral and subcaudal counts are 132, 134 and 22, 20, and the arrangement of the head shields corresponds closely with that of the holotype. The gall bladder was situated deep to ventral 96 in BM 1967.2285 and V88 in BM 1967.2284.

RELATIONSHIPS AND ECOLOGY: In its pattern and in its considerably larger size and much more robust proportions *M. jasoni* differs strikingly from the two other species of *Macrocalamus* that are known. It is further distinguished from *M. lateralis* Günther by its higher number of pterygoid teeth and from *M. tweediei* Lim by its lower ventral count. Neither *lateralis* nor *tweediei* has dorsolateral stripes, *lateralis* commonly being a uniform reddish brown above but occasionally having light chevrons on the head and nape while *tweediei*, known only from the holotype and paratype, is said to be uniform black above with a black and yellow chequered

venter (Lim 1963). None of the *jasoni* specimens has the thin pale longitudinal line along the lowermost row of dorsal scales that is formed from a whitish spot on each scale and is characteristic of *M. lateralis*, nor the bright coral red venter of *M. lateralis* (Boulenger 1912). But the most remarkable distinguishing feature of *jasoni* is its size and bulk at sexual maturity which are at least twice those of either *lateralis* or *tweediei*. Gravid female *lateralis* vary in body length from 220 to 280 mm, whereas the gravid holotype of *jasoni* measures 700 mm from snout to vent. The female paratype of *tweediei*, FMNH 109868, which according to Inger (pers. comm.) seems to be sexually mature is stated by Lim to be 348 mm, but this measurement may include the broken tail.

No differences in external meristic characters could be found between *M. jasoni* and *M. lateralis* although the ventral count of *jasoni* (131–134) is in the upper part of the wide range of variation noted in female *lateralis* (116–136, N 16).

Dental counts which were made on a number of British Museum and University of Malaya examples of *M. lateralis*, on the paratype of *M. tweediei* and on the three *M. jasoni* were found to be of value in demonstrating further differences between the three taxa. While the number of maxillary and palatine teeth in *jasoni* (M 11–13, P11) fall within the range of the counts for ten examples of *lateralis* (M 10–14, P9–12) the number of pterygoid teeth is non-overlapping. *M. jasoni* has 19, 20 and 21 in the three type specimens while 10 examples of *lateralis* from which pterygoids were dissected out varied from 13–18 (mean 16) teeth, only the type having 18. Dr Inger, who kindly examined the paratype of *tweediei* reports that the right maxilla has 18 teeth (subequal), right palatine has 13 and the right pterygoid 23. In each of these dental counts *tweediei* is outside of the range of both *lateralis* and *jasoni*. An interesting comparison can be made by analysing these figures by the provenance of the individuals. The pterygoids of seven *lateralis* obtained in the Larut Hills and Maxwell Hill vary from 14–16 while those lacking a locality have 16, 17 and 18, the highest count being in the type. The number of maxillary teeth in the type are also higher (14) than in the other *lateralis* that were examined (10–12) and this raises some doubt about the origin of the type specimen and of whether dental counts in *Macrocalamus* may vary geographically. No precise locality is available for the type of *lateralis* but Lim (1963) restricts it to Cameron Highlands. The series of *lateralis* collected on the Cameron Highlands (Lim 1963 & 1967) has not been seen by me but I would venture to suggest that an examination of their pterygoid teeth and a comparison of counts with those made on Larut Hills material would reveal whether or not dental formulae in *Macrocalamus* are subject to geographical variation, and if they are, whether the restriction of the type locality of *lateralis* to Cameron Highlands is appropriate. The higher number of pterygoid teeth in *jasoni* presumably has some dietary significance although there is no evidence of *jasoni* having different feeding habits from *lateralis*. The stomach of the holotype of *jasoni* is empty.

All three species of *Macrocalamus* occupy similar ecological niches. The *jasoni* series were obtained in a damp habitat among leaf litter or crossing the track. Lim (1963) records *lateralis* and *tweediei* from under logs in a damp environment at 6000 ft on G. Bringchang. The highest altitude from which *M. lateralis* has

been obtained is 6300 ft (Lim 1967). All other published records of the vertical distribution of this species indicate that it occurs between 3500 and 5700 ft (Boulenger 1912, Flower 1899, Smith 1922) in the Larut and Maxwell Hills, Perak, Cameron Highlands and G. Tahan, Pahang. *M. tweediei* has so far been found only on G. Brinchang, Cameron Highlands, at 5000 and 6000 ft (Lim 1963) where at the higher elevation it was in close association with *M. lateralis*. Lim (1967) described *lateralis* as being (with *Pareas vertebralis*) the commonest snakes on Gunong Brinchang and often found on the road basking in the early morning sun. Both Tweedie (1954) and Lim (1967) stated that *lateralis* eats insects and their larvae.

The specific name is appropriate in view of the striking golden ventral markings of the species; it is also cordially dedicated to the Hon. J. Jason Gathorne-Hardy, son of Lord and Lady Medway.

Pareas vertebralis (Boulenger)

Amblycephalus vertebralis Boulenger 1900 : 307.

MATERIAL: BM 1967.2277 (1 ♀).

REMARKS: This snake was found at night on a branch of a tree about 200 yards from camp 4 (5000 ft) on the trail leading to the water hole. The snake's eyes reflected a bright red in torchlight.

Scale rows	15
Ventrals	202 + 1
Subcaudals	66
Supralabials	7 (3–5)
Loreal	1
Postoculars	1
Temporals	2 + 2

RANGE: W. Malaysia (mountains of Perak and Pahang).

Pareas malaccanus (Peters)

Asthenodipsas malaccana Peters 1864 : 273.

MATERIAL: BM 1967.2276 (1 ♀).

REMARKS: Collected on the high bank at the side of the main track from Base camp, at about 800 ft. Ground colour black with irregular brownish grey cross bands bordered with white. Head silvery white.

Scale rows	15
Ventrals	158 + 1
Subcaudals	37

RANGE: S. Thailand (Yala Prov.), W. Malaysia, Sumatra, Borneo (Taylor 1965).

Family **ELAPIDAE**

Maticora intestinalis (Laurenti)

Aspis intestinalis Laurenti 1768 : 106.

MATERIAL: BM 1967.2280–81 (2 ♀).

REMARKS: Both examples were found at night on steep slopes between 2000 and 3500 ft. When disturbed, the snake made no attempt to raise its tail and expose the vivid red undersurface, contrary to the normal behaviour of this species. In life the vertebral line from behind the frontal to the tail tip was red. Flanking the line were dark brown longitudinal bands which below were edged with a white line. The undersurface of the body had broad black and white bands of equal width.

	2280	2281
Scale rows	13	13
Ventrals	239 + 1	244 + 1
Subcaudals	26	24
Supralabials	6 (3–4)	6 (3–4)
Preoculars	1	1
Postoculars	2	2
Temporals	1 + 2	1 + 2

RANGE: Thailand, W. Malaysia, Singapore, Java, Borneo.

Bungarus flaviceps (Reinhardt)

Bungarus flaviceps Reinhardt 1843 : 267.

MATERIAL: BM 1967.2286 (1 juvenile).

REMARKS: This specimen was found in an area between the disturbed forest around Base camp and the plantations near K. Damak. It is in poor condition.

RANGE: Peninsular Burma, Thailand, S. Vietnam, W. Malaysia, Sumatra, Java, Borneo.

Trimeresurus hageni (Lidth de Jeude)

Bothrops hageni Lidth de Jeude 1886 : 54.

MATERIAL: BM 1967.2290–91 (1 ♂, 1 ♀).

HABITAT: One of the individuals (2291) was found in the late afternoon among ferns four to five inches from the forest floor by a narrow stream in the valley below camp 2, at about 1600 ft. The other example was obtained in the area of Base camp at approximately 700 ft.

REMARKS: Brongersma (1933) distinguished *hageni* from *sumatranus* on the basis of colour pattern, the number of upper labials in contact with the subocular and the juxtaposition of the supranasals. Both of the G. Benom individuals have the *hageni* pattern, that is the trunk scales are narrowly edged with black but have

no black crossbands, and a light lateral line along the first and second rows of dorsals and bordered below by a series of dark spots is present. A light streak (pink in life) from behind the eye to above the last supralabial is also present. Along the sides of the body from the neck to the vent is a series of light spots which in life are pinkish in colour. The spots continue on to the proximal half of the tail where they coalesce to form pinkish crossbands. The distal half of the tail is entirely pinkish in life. In head squamation however the two specimens differ, one agrees with Brongersma's diagnosis of *hageni* in having contiguous supranasals and in two of the upper labials, the third and fourth, making contact with the subocular while the other (2290) has a small scale separating the supranasals and none of the upper labials is in contact with the subocular. The ventral and subcaudal counts for the female are 181 and 74, for the male 182 and 85.

In the British Museum collections are two additional specimens that Dr A. R. Hoge has referred to *T. hageni*. One obtained by Malcolm Smith at Kuala Teku, Pahang (BM 1936.9.12.5) is a ♂ and has 185 ventrals and 79 subcaudals. Its supranasals are in contact and on the right side of the head the third upper labial meets the subocular and on the left side the third and fourth. Its pattern closely resembles that of the G. Benom individuals. The other specimen identified as *hageni* (BM 80.9.10.7), an adult ♀, was collected in Singapore. Its counts are V185 C69 and it not only lacks the spots of the other examples but has indistinct black crossbanding on the trunk. Its supranasals are separated by a large internasal and the third supralabial (LHS) or the third and fourth (RHS) make contact with the subocular.

RANGE: I believe these specimens constitute the first published record of the occurrence of *T. hageni* in Malaya. Brongersma (1933) examined examples of the species from Sumatra, Banka, Simalur, Batu Is., Nias and Mentawei Is.

Trimeresurus popeorum Smith

Trimeresurus popeorum Smith 1937 : 730.

MATERIAL: BM 1967.2289 (1 ♀).

HABITAT: Found during the day lying motionless at the side of the narrow trail above camp 3 at about 3700 ft.

COLOUR IN LIFE: Upper surface of body uniform green, venter paler green. Tail wine red, green below.

Ventral 165
Subcaudals 62
Body length 680 mm
Tail length 133·8 mm

RANGE: E. Himalayas to Cambodia, W. Malaysia, Sumatra and Borneo.

TABLE 1

Altitudinal distribution of Gunong Benom amphibians

Altitude in feet


0
500
1000
2000
3000
4000
5000
6000
LIZARDS
SNAKES
Cnemaspis kendalli
Cyrtodactylus brevipalmatus
Draco f. fimbriatus
Draco f. formosus
Draco maximus
Draco melanopogon
Draco punctatus
Draco quinquefasciatus
Draco v. volans
Aphaniotis fuscus
Goniocephalus borneensis
Varanus bengalensis nebulosus
Varanus salvator
Mabuya multifasciata
Cnemaspis affinis
Cyrtodactylus consobrinus
Cyrtodactylus marmoratus
Gehyra mutilatus
Scincella v. vittigerum
Sphenomorphus i. indicus
Typhlops diardi mulleri
Natrix trianguligera
Macropisthodon rhodomelas
Liopeltis longicauda
Pseudorhabidon longiceps
Calamaria lumbricoidea
Lepturophis borneensis
Pareas malaccanus
Bungarus flaviceps
Trimeresurus hageni
Elaphe flavolineata
Liopeltis baliodeirus
Trimeresurus puniceus
Gonyophis margaritatus
Maticora intestinalis
Trimeresurus popeorum
Amphiesma sarawacensis
Pareas vertebralis
Macrocalamus jasoni
Altitudinal distribution of Gunong Benom reptiles
Altitude in feet

Trimeresurus puniceus (Boie)

Cophias punicea Boie 1827 : 561.

MATERIAL: BM 1967.2292–3 (1 ♀, 1 ♂).

HABITAT: One specimen was found on a tree at 1700 ft, the other on a fallen tree between Base camp and camp 2.

Ventrals 162 (♂), 158 (♀)
Subcaudals 54 (♂), 49 (♀)

RANGE: Peninsular Thailand, W. Malaysia, Sumatra, Mentawei Is., Java, Natuna Is., Borneo.

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